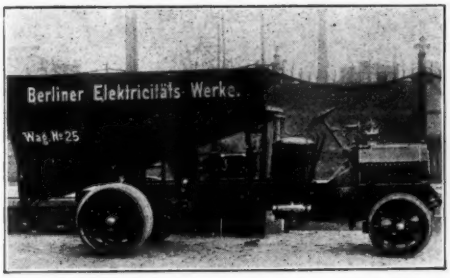
MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.



GERMAN *dump wagon of the tilting type.*

VOL. XLV. SEPTEMBER, 1913. No. 3.

The interchanging of ideas brings men in every line of business to a higher point of efficiency. The successful man of affairs is constantly seeking the experience of others, not only in his own line of work, but in other fields. He gives freely of his own, and by so doing broadens himself. Whenever the readers of MUNICIPAL ENGINEERING *are inclined to tell us of their experiences we are glad to publish them and bring about further discussions that will be of help. Give freely of your experiences and study those of others—you may gain in the exchange.*

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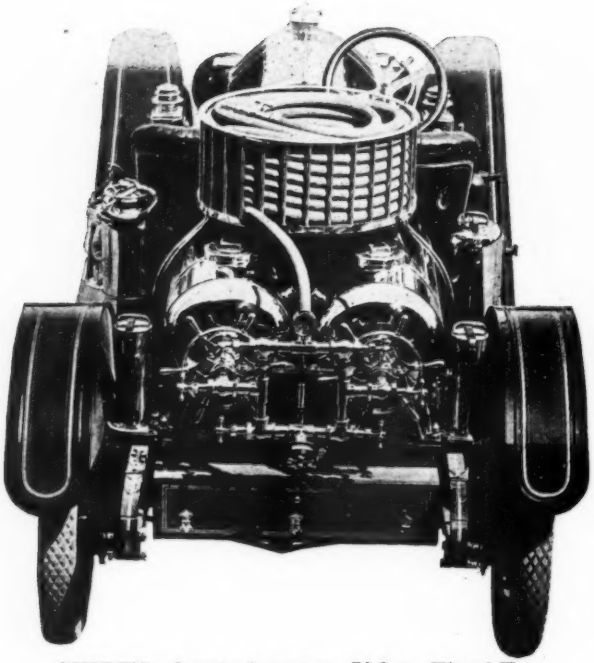


CHIEF'S *chemical wagon, 50-h.p. Kissel-Kar.*

MOTOR FIRE APPARATUS

By H. W. PERRY,
New York City

WITHIN the next ten years over $80,000,000 will be invested in motor-driven fire apparatus. The majority of this will be spent within five years. During the last eighteen months the number of pieces of motor apparatus has increased from 600 to over 2,000. There are now in use 20,000 pieces of apparatus drawn by 35,000 horses. Pittsburg is motorizing its fire department and will effect a 50% profit on the transaction. The property loss in Springfield, Mass., was $369,000 less in 1912 than in 1907. The number of motors in use between these dates was increased by 19. Isn't it self-evident that motors will eventually supplant fire horses in the U. S.? Mr. Perry has made an intimate study of this question, upon which he presents interesting facts in this article.

FIRE departments of a majority of cities in the United States will be completely motorized five years hence. Many have stopped buying horses and horse-drawn apparatus. In the light of experience and records of the remarkable economy of using self-propelled apparatus, no fire board or fire chief can feel justified in recommending future purchases of the old type of apparatus. At the annual conventions of fire chiefs, the advantages of motor apparatus and the saving it effects are the principal subjects of addresses and discussions, while the display of apparatus is entirely of the self-propelled type.

The revolution in transportation methods that was promised by the manufacturers of motor vehicles is coming about more quickly and completely in the field of fire fighting than in any other. There are good reasons why this should be the case, yet the decision of the fire commissioners of New York, Boston and other big cities to place entire dependence upon the reliability and efficiency of motor equipment should be the most convincing argument to business men

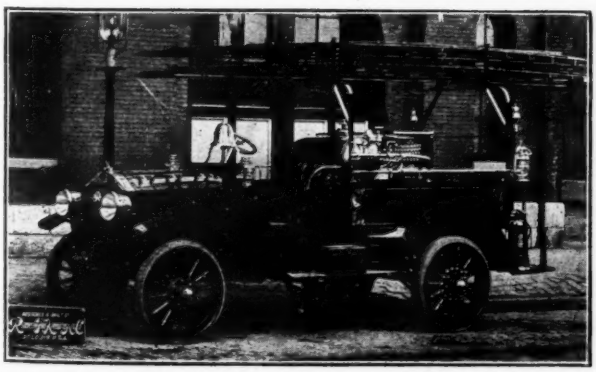
that motor trucks and delivery wagons are in a sufficiently advanced stage of development to prove satisfactory in industrial and commercial work.

SOME of the reasons for the rapid substitution of motor propelled apparatus for horse drawn and the change of attitude by fire chiefs.

It was the superior speed of the motor car that first commended it to fire department officials, but they were long skeptical of its reliability and economy. The large cities especially were very conservative toward motor apparatus. New York, Chicago, Boston, Philadelphia and other big cities were notoriously slower to adopt the motor chemical and hose car and the motor fire engine than were hundreds of smaller cities and villages. Within the last year or two, however, their attitude has changed completely, and they are taking the lead in substituting motor apparatus for horse-drawn equipment. New York last year had fifty-nine pieces of apparatus, including chiefs' and deputies' cars and runabouts, and the budget for 1913 included an appropriation for the purchase of eighty-seven additional pieces. More than a score of new fire houses, to be completed as soon as possible, were designed with a view to housing motors instead of horses, or after the horses have been superseded. Fire Commissioner Johnson told the writer fully two years ago that the New York fire department would be completely motorized as rapidly as possible and that probably within five years the last of the horses would be sold. This means the displacement of 1,500 horses, and an expenditure of $2,500,000 in the gradual conversion to motors.

Paris has advanced much further in this direction than American cities, the municipal council of the French capital having decided to abolish horses from all municipal service. Following a test of various types of motor vehicles by the street cleaning department last year, the authorities have recently put into service a large number of combination street watering and sweeping machines and electric garbage wagons. In five of the twenty city wards the horse had been displaced by these machines up to last April, and other wards had made a partial change. Motor fire apparatus has been used for years in most of the capitals of Europe, particularly Paris, Berlin, London, Glasgow, Dublin, Vienna and Rome. Doubtless it will be some years before American cities reach the advanced position of Paris, but it is certain that in time all big cities will abolish horses from municipal service, and some will prohibit or restrict their use by private citizens.

Pittsburg is motorizing her fire department rapidly, a process that John H. Dailey, director of the department of public safety, estimates will take about three years to complete. He predicts that there will hardly be a city of any size in the United States in five years where fire apparatus is not mostly self-propelled. His prediction is based on personal experience with the efficiency and



A TYPE of motor apparatus which has saved property owners many thousands of dollars. It is speedy and equipped with necessary ladders and chemical tanks to extinguish small fires before they reach a point of doing much damage. Built by Robinson Fire Apparatus Co.

economy of motor equipment. Figures compiled from records of the cost of maintaining and operating the present motor apparatus indicate that the first year's saving in expense will be almost double the cost of complete motorization. The cost of keeping a chemical and hose car he found to be approximately $55 a year, as compared with $600 a year for each piece of horse-drawn apparatus. The city maintains 131 pieces of apparatus and keeps 25 extra horses, equivalent to 12 more pieces, making a total of 143, not including runabouts and horses used by the chief engineer and district chiefs. At $600 a year these cost $85,800, while an equal number of motor pieces at $55 would cost $7,865, thus effecting a direct saving in maintenance and operation of $77,935 a year. To this is added $7,000, now lost each year through death of horses, and about $143,000 saved in salaries of 116 men, who will not be needed in the department after complete motorization, as that number now do nothing but take care of horses. Twelve engine houses now in use can be dispensed with after motorization without decreasing the efficiency of the department, in the opinion of the director, because of the speed and increased radius of the machines. It is estimated that these pieces of property can be sold for at least $500,000. All these savings aggregate $727,000, while the cost of motorizing will be about $500,000, leaving a profit of nearly 50 per cent. on the transaction.

POWERFUL *three-stage centrifugal turbine pump in use in Tacoma, Wash. Capacity, 1,000 to 1,200 gallons per minute. Manufactured by The Seagrave Co.*

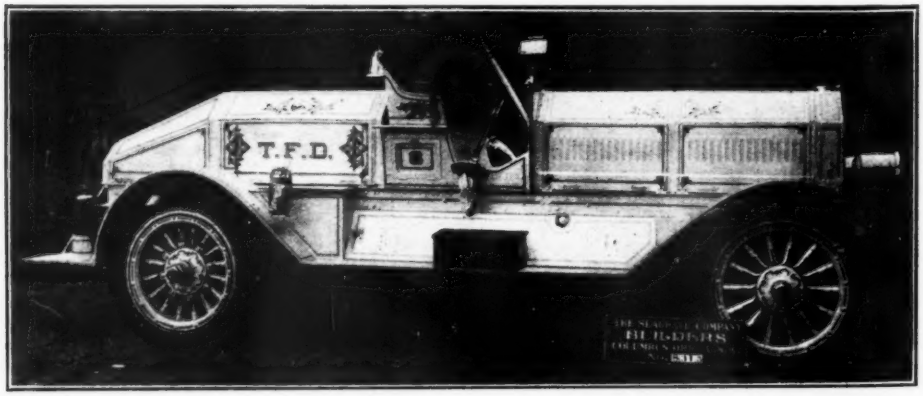
¶ OFFICIALS *who continue to buy horse-drawn apparatus are not guarding the best interests of taxpayers.*

Upon such a showing as this it is plain that any fire committee or board of safety that continues to sanction the purchase of horse-drawn apparatus without a careful investigation of power equipment is remiss in its obligations to public office, one of which is to conduct its department with the utmost economy consistent with maximum efficiency.

Boston's attitude is shown by the recent request of her fire commissioner for an appropriation of $150,000 a year for two years for the purchase of six triple combination motor pumping engines, six combination motor chemical and hose cars, and six combination motor chemical and ladder trucks to replace the present horse-drawn, and two additional two-wheeled tractors and five four-wheeled tractors for horse-drawn ladder trucks.

Chicago is motorizing rapidly. A year ago she had two motor fire engines, several chemical and squad wagons and seven chiefs' and assistants' cars. Thirteen chemical and squad machines have been added since then. The Chicago Fire Insurance Patrol has recently bought six combination chemical and hose cars and five patrol trucks for carrying men and protective tarpaulins for salvage work.

The effectiveness of the motor chemical



for fire work has been proved in Chicago, where in nine cases out of ten the chemical engines have the fire out before the horse-drawn steamer arrives at the scene. On one occasion at least one of these had put out a fire and returned half way to the fire house before it met the steamer with horses on the dead gallop just answering the alarm.

COSTS *which prove the great savings effected in one city.*

Springfield, Mass., was one of the first cities in the country to adopt motor apparatus and her experience with it has been so satisfactory that the board of aldermen made an appropriation last May of $24,000 for additional motor equipment. This was in addition to $12,000 in the municipal budget for the same purpose, making $36,000 available this year.

Thousands of dollars are being saved every year by the use of motor apparatus in the Springfield department, as shown by a table of comparative costs of upkeep of horse and motor equipment prepared by the board of fire commissioners for the year ended March 31st, last. The figures are given below.

HORSE-DRAWN APPARATUS.

	Runs.	Regular upkeep.
Truck No. 8	107	$620.42
Hose No. 10	143	427.94
Totals	250	1048.36
Averages	125	524.18

This shows an average saving of $362.29 a year on each piece of motor apparatus and an average of 49 more runs by the motor trucks than by the horse-drawn, while the horse-drawn hose wagon made five more than the average of 138 runs made by the motor hose trucks. The charge for alterations of motor truck No. 1 was for changing the location of the batteries and other improvements, and the charge of $625 against motor hose No. 1 was for rebuilding or completely overhauling the truck, which occurs at intervals of several years. Eliminating these charges, it is found that the average regular maintenance expense for the

MOTOR APPARATUS.

	Runs.	Regular upkeep.	Alterations.	Total.
Truck No. 1	148	$55.32	$225.00	$280.32
Truck No. 10	165	65.21	.....	65.21
Hose No. 1	192	55.71	625.00	680.71
Hose No. 7	216	31.86	.....	31.86
Hose No. 8	110	37.40	.....	37.40
Hose No. 12	109	22.17	.....	22.17
Hose No. 13	63	15.61	.....	15.61
Totals	1003	283.28	.....	1133.28
Averages	143	40.46	.....	161.89

WHITE HIGH *pressure service machine which assists the chief who has control over the amount of water pressure necessary at a fire.*

motor apparatus was only $40.46 each, as compared with $524.18 for the horse equipment.

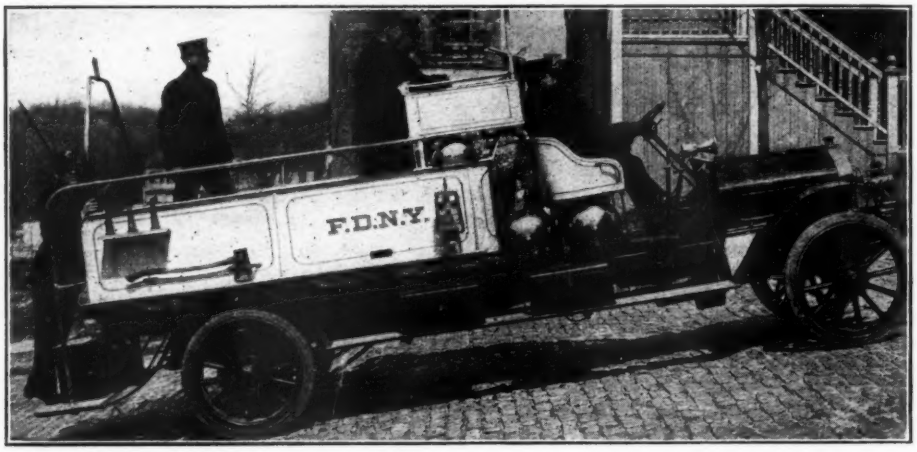
Director of Public Safety C. W. Stage, of Cleveland, predicts that not a single horse will be in use in the Cleveland fire department five years hence. An appropriation of $45,000 is to be expended for additional motor apparatus, including equipment for two new companies and flying squadrons. Eight motor vehicles are to be purchased for the fire department. A separate appropriation has been made for four motor patrol wagons for the police department.

Toledo passed an ordinance last winter providing for a bond issue of $200,000 to be used for motorizing the fire department. The sale of fire horses and displaced apparatus will add about $70,000 to this amount, making a fund that will be large enough to provide for a motor truck for the fire alarm telegraph service, several machines for the police department and cars for the electrical, building and smoke inspectors.

Some of the southern cities are fully as progressive as their northern sisters, in this direction. For example, Macon, Ga., has disposed of the last piece of horse-drawn fire apparatus. During the last three and one-half years it has put into service four motor fire engines and hose trucks, two chemical and hose trucks, one hook and ladder truck and one city service truck. The total expenditure has been $55,650.

Whereas in general haulage, such as contractors' work, the motor truck effects its greatest saving by being kept in motion as much of the time as possible, the conditions are exactly reversed in fire service, the greatest economy occurring during the idle time in the fire house. This is due to the fact that there is no depreciation or wear and tear of the apparatus and no fuel consumption in the engine house, whereas horses eat and grow old the same when idle as on the street. Furthermore, horses require a great deal more attendance at all times than motor equipment, occupy more stable room, and require storage space for feed. The motors, being faster and tireless, can protect greater areas, so that fewer fire houses and fire companies are needed. All of these effect a direct saving in the expense of the department.

There are other economies, however, that are enjoyed by the community, but which can not readily be calculated and which do not appear in the annual reports and recommendations of the fire commissioners. One of these is the reduction of insurance rates that follows the motorizing and increased efficiency of the department in any city, and another is the actual reduction of property loss by fire resulting from the more prompt ar-



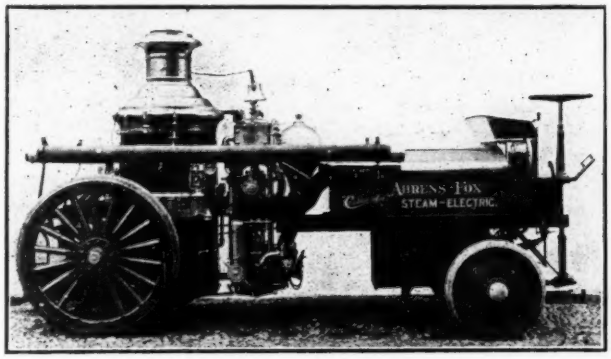
CLIMBING *Gunboat Hill, New York, with one of the thirty-five Mack combination chemical and hose trucks which are used in this city.*

rival of motor apparatus and the extinguishing of fires before they have gained much headway.

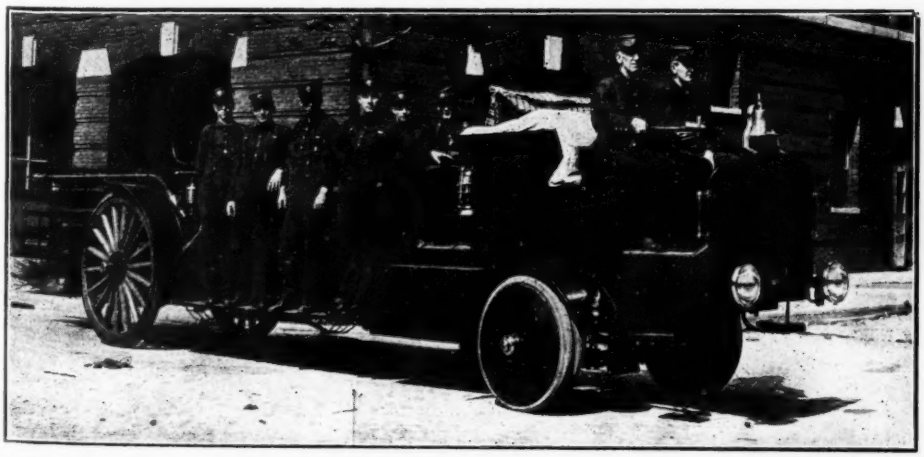
AN ACTUAL *reduction of* $269,000 *has been made by this city as a result of the installation of nineteen pieces of motor apparatus. The result of this efficiency has been a reduction in fire insurance rates.*

A report submitted recently by the fire commissioner and chief engineer of Springfield, Mass., throws interesting light on how effectual motor apparatus really is in reducing fire loss, and why the insurance companies are willing to make substantial reductions in premium rates in cities whose departments are motorized. This report states that there are now 22 pieces of motor apparatus in the service of the Springfield department, and compares the fire loss last year with that of five years ago—1907—as follows:

Year.	Motors.	Alarms Answered	Property Loss.
1907	3	489	$535,000.00
1912	22	829	166,000.00
Difference			$369,000.00



TWO *different types of horse-drawn apparatus which have been motorized by attaching Couple-Gear electric tractors.*



NOTT *six-cylinder fire engine and hose wagon with a pump capacity of* 900 *gallons per minute against* 150 *pounds pump pressure.*

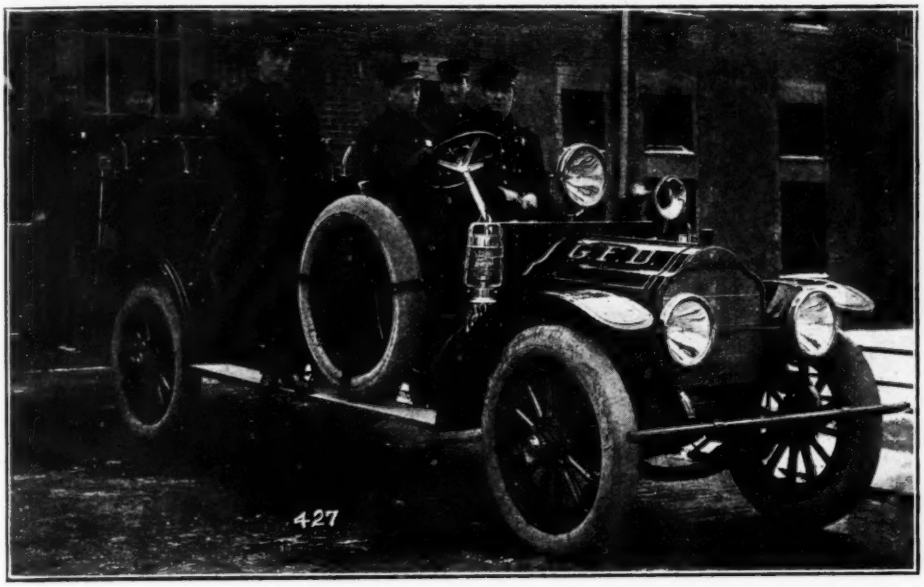
A single bad fire in 1907 accounted for a large part of the difference in property loss, yet it is evident that the motor equipment has enabled the department to take care of almost double the number of fires with greatly lessened property loss.

Economy of maintenance is of secondary importance, of course, to efficiency and dependability. But motor apparatus has now been in actual service in many cities for varying periods, and its efficiency and reliability can be testified to by so many fire authorities that there is no good ground for entertaining doubts of these points any longer. Fire Chief Kenlon, of New York, touching on this matter, made the statement that in six months the motor-drawn steamer in the metropolitan department answered nearly 500 alarms, and in no case had failed to reach the fire, in most cases in better time than the horses. As a result of this record, the department ordered 28 additional motor tractors. Fire Chief Bowker, of Passaic, N. J., in a paper before the last International Convention of Fire Engineers, reported that he had had two motor tractor ladder trucks in service for eighteen months, and not once in that period had trouble been experienced in starting when answering an alarm, and that they had always arrived at and returned from fires without any trouble or delay.

Chief Smart, of Calgary, Canada, reported to the same meeting that he had had in use for three winters a 40-h. p. squad truck and that in that time it never had been tied up and never failed to reach the fire under any weather conditions. Superiority of the motor was particularly demonstrated when streets were covered with sleet or hard-frozen snow, making them impassable for horses, but presenting no difficulties to the motor apparatus.

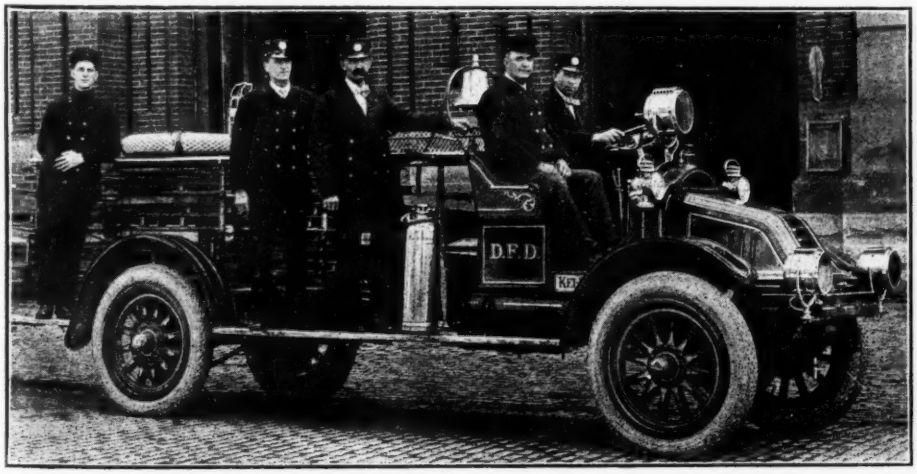
Following a continuous snowfall of 24 hours in Passaic, N. J., the department received an early morning alarm from the hill section. After returning from the fire the registering speedometer showed fifteen miles an hour, according to Chief Bowker, and this was made up hill through deep, unbroken snow.

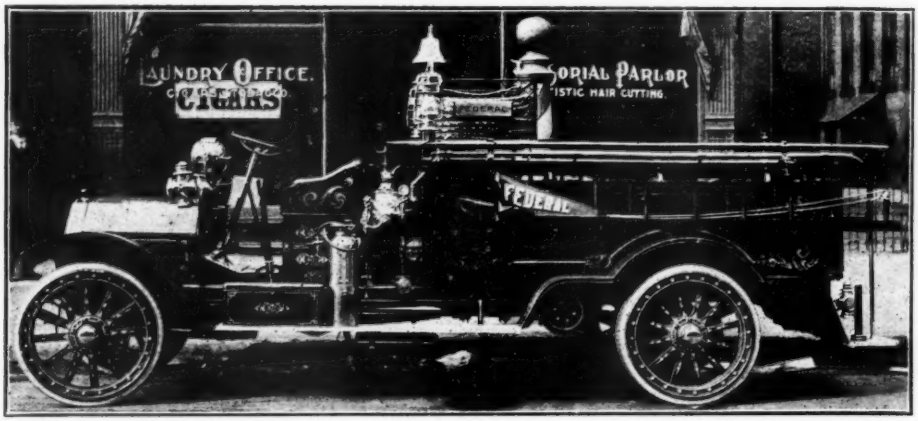
Many fire chiefs favor motor tractors because these permit the retention of the present steamers, aerials and water towers. There is, of course, an undeniable economy in this, as the sale of present apparatus would net only a small return on the original investment. Where new equipment is to be bought for extensions of the fire service this factor does not enter. However, in the case of the fire engine, there is reluctance to abandon the steamer, with its long-proved dependability, in favor of the gasoline pumping engine. Until sufficient tests in actual service have fully demonstrated the ability of the gas-driven pump to operate at full power continuously as long as necessary, and to throw as powerful a stream and as large a volume of water as a steamer, the tractor system combines the speed



UPPER VIEW—*Garford emergency hose and chemical wagon. This type of apparatus is often used to carry firemen trained in laying out the work of the apparatus and men that follow at a slower speed. It is often possible for them to extinguish a small blaze without further assistance. Such a type is particularly valuable where the majority of the department apparatus is horse-drawn.*

LOWER VIEW—*Kelly hook and ladder equipment on a one-ton chassis in use at Delaware, Ohio.*





A VERY *completely equipped combination chemical and hose truck in use at Portland, Ore.; Attleboro, Mass.; Tupelo, Miss. Manufactured by Federal Motor Truck Co.*

and economy of motor service with the dependability of the steam engine.

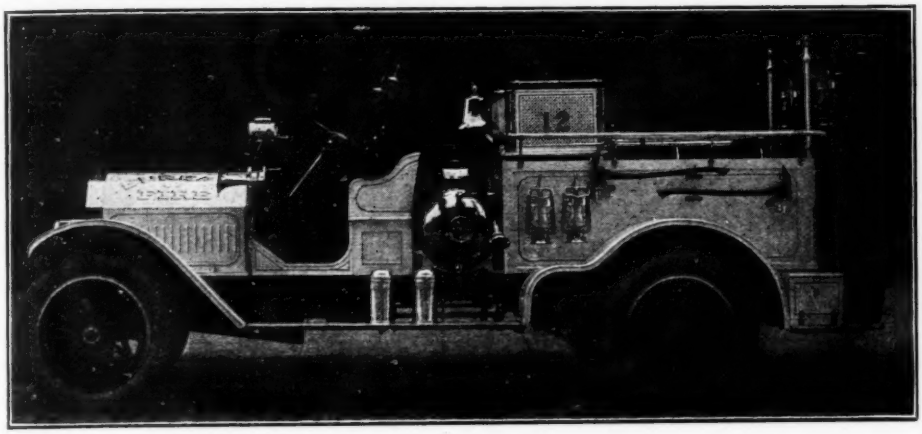
Eventually, however, the motor fire engine will demonstrate its superiority because it is lighter, faster, and more easily controlled in traffic than the cumbersome combination of a tractor element and a steam pumping engine. In the motor engine, one power plant serves the dual purpose of driving the apparatus to the fire and driving the pump to throw water upon it, whereas any system that permits retention of the steamer involves two power plants, one of which is necessarily idle while the other is working. Another disadvantage is that the motor propelled steamer does not have time to get up sufficient steam on the way to a fire to be effective at once upon its arrival, whereas a motor engine has available the full power of its engine immediately. Most of the tractors at present in successful use are of the electric type, but there have been some attempts to combine gasoline engines and steamers to form a self-propelled unit. Besides the great weight of such an outfit, there is the added element of danger in the proximity of a gasoline-using engine to the fierce open fire and dropping coals of a steam engine.

Regarding the present reliability of motor fire engines, we have the testimony of Fire Chief Magee, of Dallas, Tex., who cited one occasion when, after getting to a fire in record time, the motor pumped water for three lines of hose for 17½ hours and for one line of hose for three hours longer. Fire Chief Ballantyne, of Savannah, Ga., a city of 100,000 inhabitants, which is completely motorized with 14 pieces of apparatus, has reported an occasion when it was necessary to put seven motor pumps hub deep in new-made ground where horses could not go, at a fire on the city's water front. The motors pumped 21 streams for 8½ hours and three streams for 13 hours without any sign of trouble. All the pumps ran at full speed continuously.

FIRE engineers in their annual convention will bring forth a vast amount of valuable data.

No doubt that much more testimony on the efficiency, reliability, and economy of motor apparatus will be forthcoming at the Forty-first International Annual Convention of Fire Engineers, to be held in New York City the first week in September, and that the exhibition of apparatus will prove most entertaining and instructive.

It developed at the last convention that there were few cities of 10,000 population and over that did not possess one or more pieces of self-propelled apparatus. Since then there has been greater activity than ever before in the purchase of such



AMONG *the types of hose and chemical trucks, with which Philadelphia is equipped, is the Boyd.*

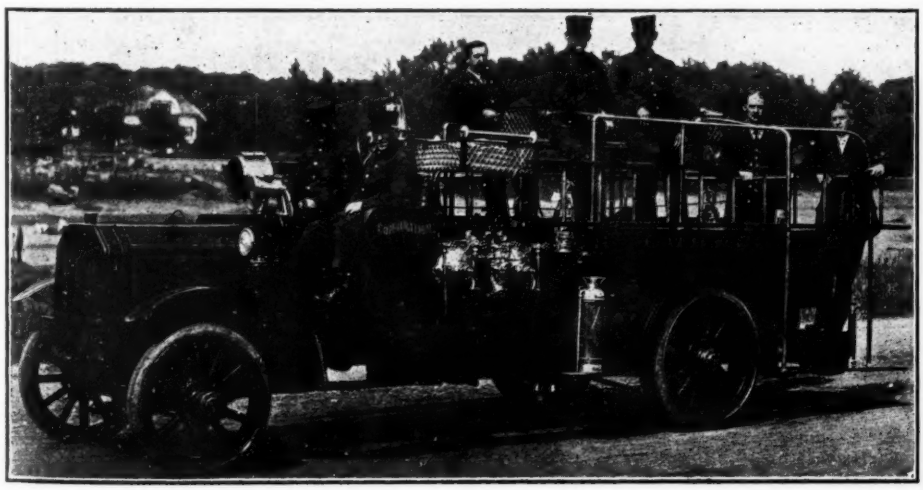
equipment. Bi-monthly records show that the number of cities buying or installing motors has run from 60 to 100. It is safe to say that at present an average of from 40 to 50 cities contract for or install one or more pieces of fire apparatus per month.

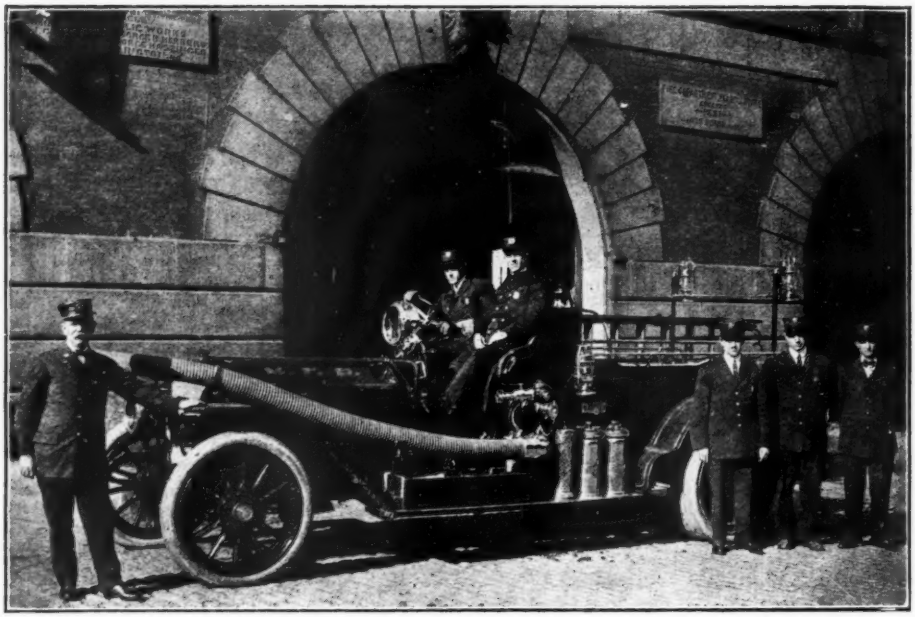
At the beginning of the year 1913 there were 629 pieces of fire apparatus in use by 180 leading American cities of 8,000 population and up, not including fire chiefs' cars and deputies' runabouts. These were classified as follows:

Combination chemical and hose trucks	257
Pumping engines	103
Triple pumpers	45
Hose trucks	47
Chemical, hose and ladder trucks.	34
Tractors	24
Aerials	20
Auxiliary trucks	85
Service trucks	14
Total	629

The number of self-propelled vehicles in these cities, including chiefs' cars and runabouts, increased from 448 in 1911 to 911 in 1912, thus more than doubling,

THE SPEED *of this Peerless three-ton chemical hose and ladder truck, in use at Cohasset, Mass., is restricted by ordinance to 14 miles per hour.*

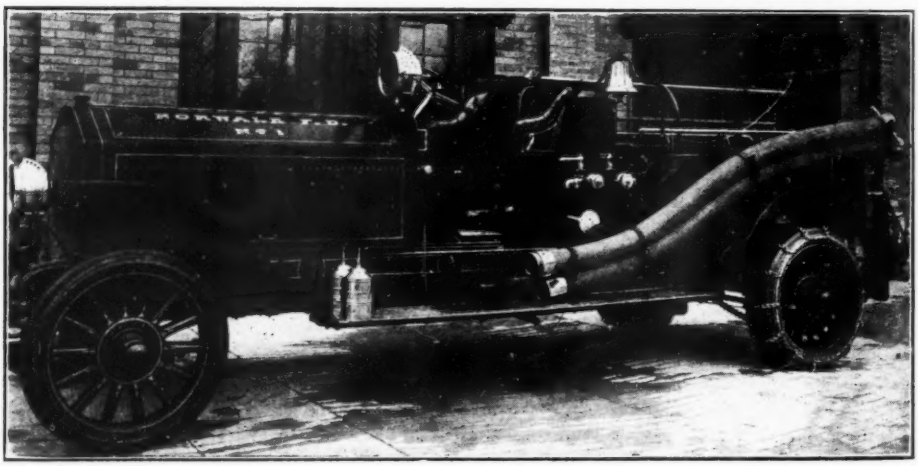




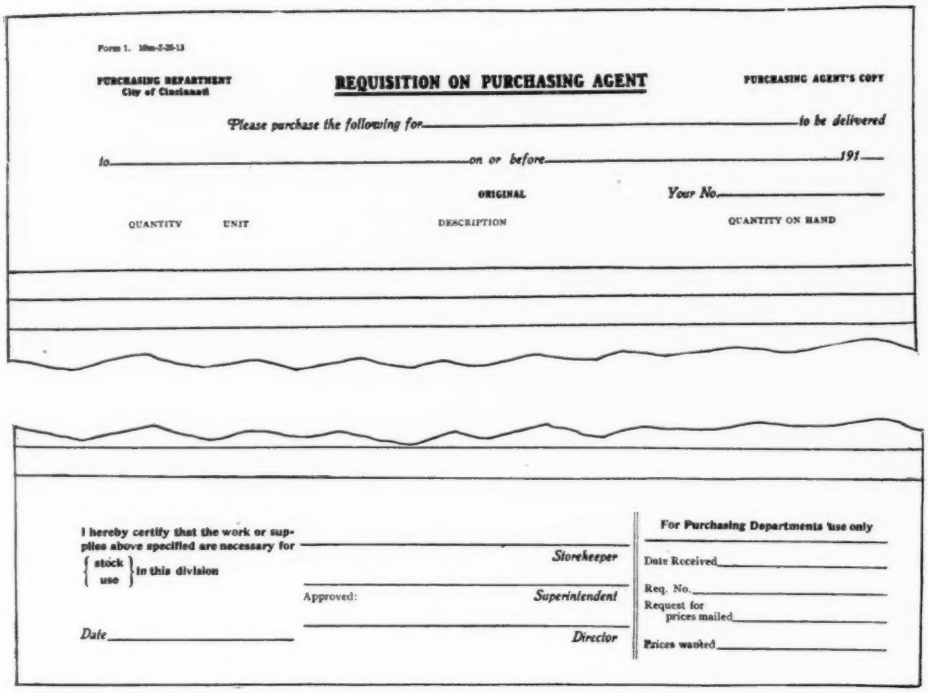
TO APRIL *tenth this American-La France pumping engine, type* 12, *in use in Memphis, Tenn., made* 133 *runs, covering* 558½ *miles in* 62½ *hours out of quarters. Chief John E. McFadden standing near front and Capt. B. O'Neil seated at the left of driver.*

while the number of pieces of horse-drawn apparatus decreased in the same period of one year from 3,689 to 3,483, or 209.

In 24 cities the average total cost per month of keeping and using a combination motor chemical and hose truck, including general repairs, new tires, gasoline and oil, was $7.70. These figures are for an average period of 18 months in service.



AMERICAN LA FRANCE *type* 15, *six cylinders,* 122-*h.p., in use at Norwalk, Ohio. Pumps* 750-950 *gallons per minute, developing with* 1¾ *S. B. nozzle a pressure of* 70 *lbs.*



Form 1. 10m-5-28-13

PURCHASING DEPARTMENT
City of Cincinnati

REQUISITION ON PURCHASING AGENT

PURCHASING AGENT'S COPY

Please purchase the following for _____ *to be delivered*

to _____ *on or before* _____ *191*__

ORIGINAL

Your No. _____

QUANTITY	UNIT	DESCRIPTION	QUANTITY ON HAND

I hereby certify that the work or supplies above specified are necessary for { stock / use } in this division

_____ *Storekeeper*

Approved: _____ *Superintendent*

_____ *Director*

Date _____

For Purchasing Departments use only

Date Received _____

Req. No. _____

Request for prices mailed _____

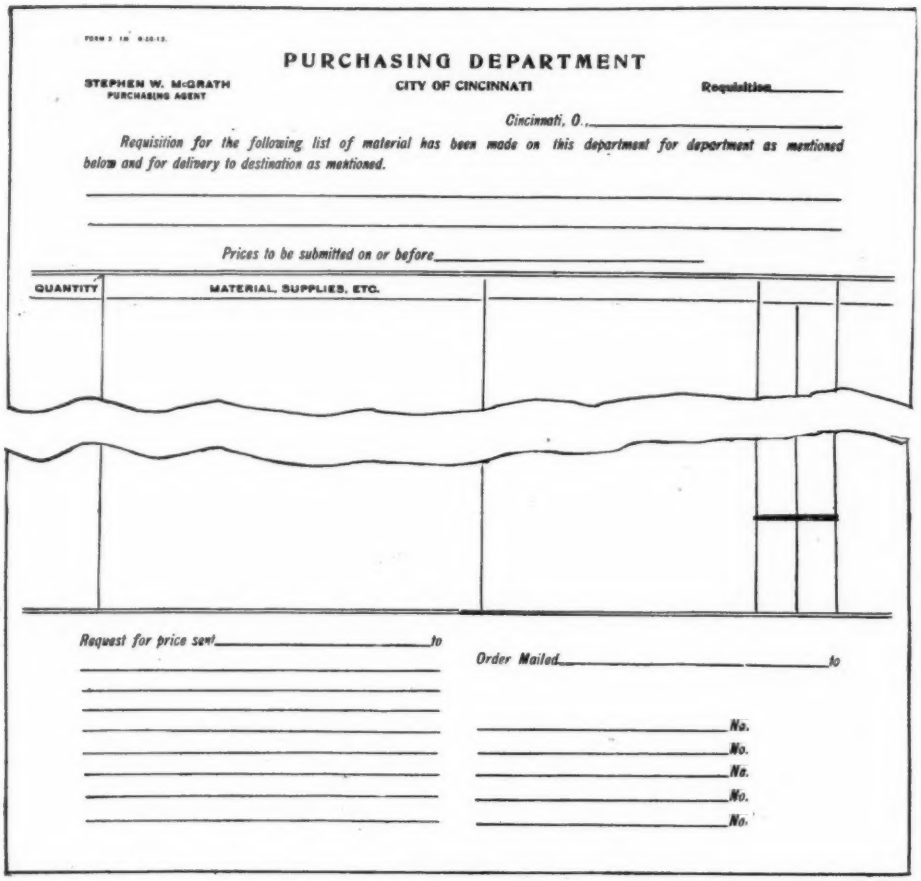
Prices wanted _____

PLATE I. *Copies of this form are in the offices of each department for which the purchasing agent buys supplies. Properly signed, this becomes a valid order for the agent to make purchases.*

CINCINNATI'S PURCHASING SYSTEM

A Compact System so Simple and Complete that Information on Any Purchase can be Secured Immediately. The Expense of Conducting the Department Is Only Two Per Cent of the Amount Purchased. The System Is Based Upon and Operated by Business Methods and Is a Model for Cities, Large or Small.

WHEN the present administration of the city of Cincinnati came into office approximately two years ago it fell heir to a purchasing department which was such in name only. The prior administrations had failed completely to make this an effective and efficient adjunct to their offices. The only records inherited by the present department were a few cards recording telephone numbers of the favored vendors of supplies. Prices were not codified; requisitions were filed in such a manner as to make the information contained in them useless; competition among supply dealers had ceased; a few received orders at their own terms; the quality of the goods purchased suffered



PURCHASING DEPARTMENT

STEPHEN W. McGRATH
PURCHASING AGENT

CITY OF CINCINNATI

Requisition_____

Cincinnati, O._____

Requisition for the following list of material has been made on this department for department as mentioned below and for delivery to destination as mentioned.

Prices to be submitted on or before_____

QUANTITY	MATERIAL, SUPPLIES, ETC.		

Request for price sent_____to

Order Mailed_____to

_____No.
_____No.
_____No.
_____No.
_____No.

PLATE II. *This bears a full description of the supplies upon which bids are to be received. It is posted on a bulletin board in the purchasing department under the day upon which bids will be opened for this class of goods.*

wide fluctuations; standardized articles were unheard of; thirty different departments would requisition thirty different kinds of paste, pencils, and pens. Conditions were chaotic.

The department had to be created anew. A successful business man, a manufacturer who had just retired, was chosen to undertake the task. That Mr. Stephen McGrath has given to the city of Cincinnati an efficient purchasing department, one based upon the best business principles, is evidenced by several pronounced facts. This department during the past year has saved the city a trifle over 10 per cent. on purchases aggregating three-quarters of a million dollars, the expense of conducting this department has been 2 per cent. of the gross purchases; and most convincing of all, the system is so simple and easily expanded that like all such methods which result in high efficiency it seems strange that it has not long since been inaugurated by this city and others over the country. There is no reason why its basic principles should not serve as a model for many hundreds of American cities seeking up-to-date methods of purchasing.

Enlisting the experience of the larger private corporations, Mr. McGrath, with the aid of a vast amount of data and suggestions from the Bureau of Municipal

Research through its accounting director, F. R. Leach, outlined and put the plan in operation.

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¶ A TRIPLE *check on the requisition prevents errors and collusion and gives the purchasing agent full authority to buy.*

Requisitions for supplies as needed by the various departments are made on forms, Plate 1, supplies of which are in each department. This form is the standard used in requisitioning the purchasing agent for all supplies. Before this order can be considered it must in all cases bear the signature of the store keeper, who declares the need of such supply; the department superintendent which shows his approval; and finally the director, or mayor if need be, who authorizes its fulfillment. It then becomes full authority for the purchasing agent's action. A copy known as the "Requisitioner's Copy" is made in carbon at the same time on a yellow sheet and retained by the storekeeper and bears his number. The purchasing agent's copy is then dated and given a serial requisition number. This number, which is absolutely independent of the requisitioner's number, becomes the means of identification of this purchase in the agent's office and is controlled and indexed by means of a card index which will be described later.

The requisition then goes to the standardization clerk, Edwin Waller, whose work has done much to place this department upon an efficiency footing. He checks the correctness of the order, determines whether or not the supply needed is properly described, that it conforms to a standard, if one has been set for this article, sees that it is of the most suitable quality and in the units necessary. He also recommends the most advantageous method of purchase and gives his opinion of the market conditions.

It is then ready for the order clerk, who copies on the form shown in Plate II a description of the supplies. This then goes to the bulletin board, where the merchants and vendors are advised of purchases to be made. Certain days have been set aside for the purchase of certain articles and only upon these days will such supplies be bought. This plan of definiteness as to purchases has resulted in concentration at all times on the article to be secured and is a great convenience to bidders, as it makes their presence necessary but once a week. Notices of purchases are posted sufficiently ahead of the day of buying so that advantage may be taken of as much competition as possible. Nothing is purchased without this public announcement, except goods which have been covered by contract agreement, which agreements have been entered into in the same public manner as already outlined.

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¶ EVERY *effort is being made to furnish vendors with adequate information upon articles for which bids are asked.*

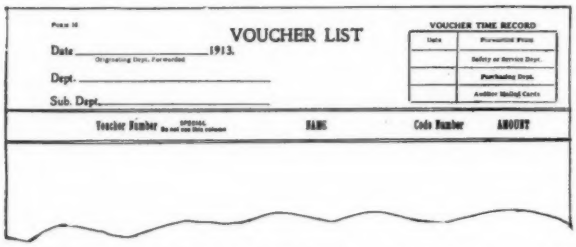
Below the bulletin board are cases containing samples, in so far as practical, of many articles which are standard with the city. Thus a contractor can often make a careful examination of the exact article needed and thereby bid with the greatest degree of intelligence.

In cases where unusual or important purchases are to be made post cards are sent to prospective bidders announcing that the city is in the market for certain supplies.

The bidder specifies his bid on a sheet, Plate IV, provided by the department, and files it in a sealed envelope, addressed to the purchasing agent, in a locked box in the agent's office. Upon the day and at the time specified the bids are then publicly opened and read in the presence of the interested bidders. Bids are carefully computed, and compared with the prices of similar articles purchased in the past. These records of past purchases are the most valuable assets in the purchasing agent's office. They will be described later.

The lowest bidder having been determined, the order is then made out in quintuplicate by means of typewritten carbons on tinted sheets each of a differ-

ent color and duplicates in every respect. All receive the signature of the purchasing agent, which shows that the order has come to him properly endorsed. The general form of these five sheets is exhibited in Plate V. Two copies are for the city auditor, one for the purchasing department and one for the requisitioner and one for the successful bidder.


VOUCHER LIST

Date _____ 1913.

Dept. _____

Sub. Dept. _____

VOUCHER TIME RECORD

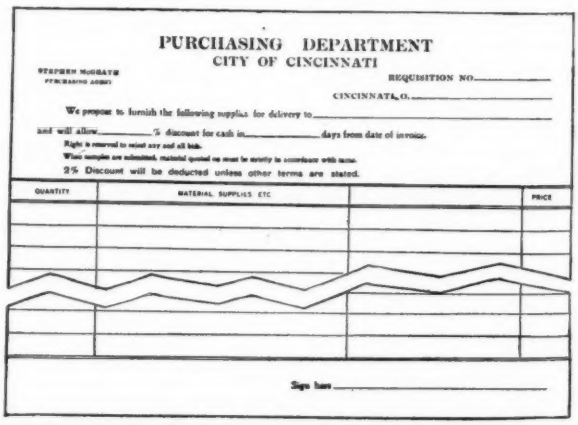
Voucher Number | Name | Code Number | Amount

PLATE III. *When all papers relative to an order are filed in the purchaser's office, a record of the passing of bills for vouchering to the city auditor is kept on this form.*

The auditor investigates the fund from which payment is to be made and debits this fund with the amount of the order. Thus payment is guaranteed and payment more than once prevented. This also serves as a check on the purchases of each department, preventing the incurring of liabilities beyond the amount appropriated. After the auditor has encumbered the funds of the department in question, the white sheet or "Auditor's Record" is returned to a file in the purchasing agent's office, which is known as the inspector's file. This file is divided into as many parts as there are departments for which supplies are purchased, each compartment being horizontal and approximately an inch and a half in depth and of a size capable of receiving all sheets flat. One side is specified as "open" and the other as "closed." The auditor's copy remains in the open side of the file until the goods have been delivered to the department ordering them.

Each day the three purchasing department inspectors receive from the departments assigned to them post cards similar to that shown in Plate VI advising them that certain supplies have been received. The inspectors then examine the articles and either reject or approve them as to quality, quantity and specifications on which they have been purchased. When the articles finally fulfill the inspector's demands he so certifies on the auditor's record and this record is then placed in the "closed" pigeon hole and the transaction is complete to the point of invoicing for the auditor. At the close of each day the three inspectors make full reports of the materials inspected by them on loose leaf sheets which are bound in a loose leaf binder. This report is made on a sheet seven inches wide, which is divided into seven spaces, these spaces being headed as follows: date of order, order number, requisition number, department, supplies or materials inspected, vendor, remarks. A single line is used for each order. This report serves as a complete record of each day's work of each inspector and shows the condition the goods as delivered to the requisitioning department.

The invoice clerk in the purchasing department attaches the vendor's invoice to the now completed auditor's record,


PURCHASING DEPARTMENT

CITY OF CINCINNATI

STEPHEN McGRATH
PURCHASING AGENT

REQUISITION NO. _____

CINCINNATI, O. _____

We propose to furnish the following supplies for delivery to _____

and will allow _____ % discount for cash in _____ days from date of invoice.

Right is reserved to reject any and all bids.

When samples are submitted, material quoted on must be strictly in accordance with same.

2% Discount will be deducted unless other terms are stated.

QUANTITY | MATERIAL, SUPPLIES, ETC. | | PRICE

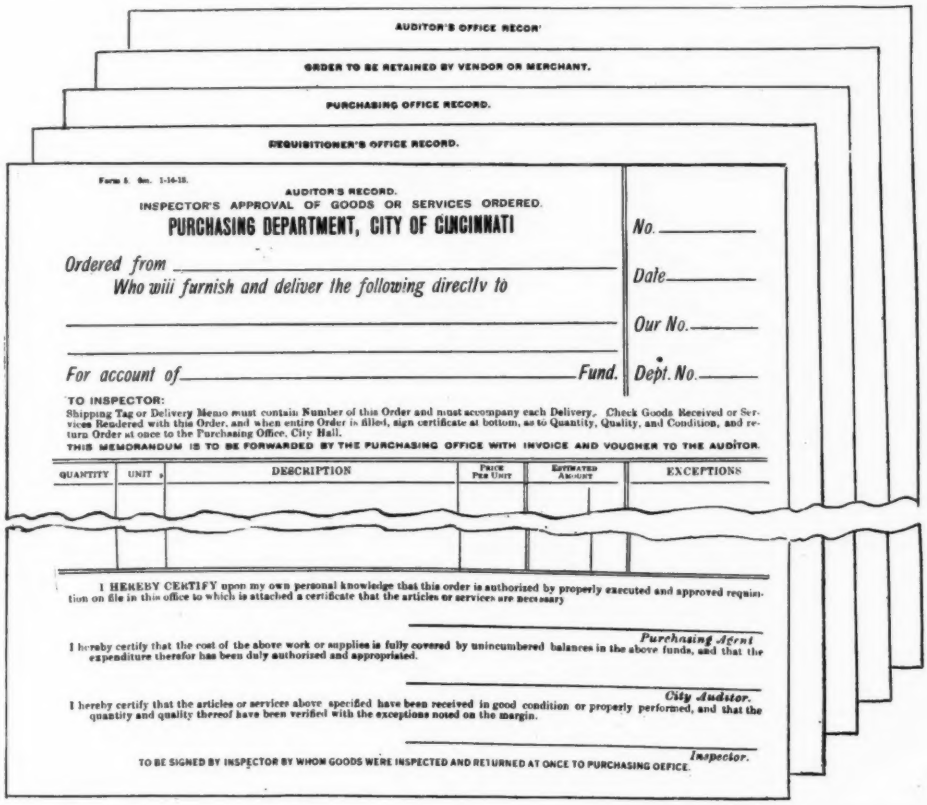
Sign here _____

PLATE IV. *All bids are submitted by the bidder on this form.*

which shows that the transaction has been completed in every manner and that the auditor has full authority to make payment for goods, which have been delivered in exact accordance with the demands of the department issuing the requisition and with the standards and terms set by the purchasing department.

A transaction has now been effected in which all concerned are fully aware of every detail. It has been so accomplished that there can be no opportunity for collusion, no misunderstanding and little possibility for errors. The purchase is scrutinized from every point. The need has been definitely established, the supplies have been made to conform to certain standards of quality, they have been purchased in open competition, have been bought with funds actually available, and have passed a rigid inspection.

The work of this department and that of regimes to follow has been greatly enhanced in value by a system of recording and filing of all information regarding past purchases.



AUDITOR'S OFFICE RECOR'

ORDER TO BE RETAINED BY VENDOR OR MERCHANT.

PURCHASING OFFICE RECORD.

REQUISITIONER'S OFFICE RECORD.

Form 1 Rev. 1-16-13.

AUDITOR'S RECORD.

INSPECTOR'S APPROVAL OF GOODS OR SERVICES ORDERED.

PURCHASING DEPARTMENT, CITY OF CINCINNATI

No. _____

Ordered from _____

Who will furnish and deliver the following directly to

Date _____

Our No. _____

For account of _____ Fund.

Dept. No. _____

TO INSPECTOR:

Shipping Tag or Delivery Memo must contain Number of this Order and must accompany each Delivery. Check Goods Received or Services Rendered with this Order, and when entire Order is filled, sign certificate at bottom, as to Quantity, Quality, and Condition, and return Order at once to the Purchasing Office, City Hall.

THIS MEMORANDUM IS TO BE FORWARDED BY THE PURCHASING OFFICE WITH INVOICE AND VOUCHER TO THE AUDITOR.

QUANTITY	UNIT	DESCRIPTION	PRICE PER UNIT	ESTIMATED AMOUNT	EXCEPTIONS

I HEREBY CERTIFY upon my own personal knowledge that this order is authorized by properly executed and approved requisition on file in this office to which is attached a certificate that the articles or services are necessary

_____ Purchasing Agent

I hereby certify that the cost of the above work or supplies is fully covered by unincumbered balances in the above funds, and that the expenditure therefor has been duly authorized and appropriated.

_____ City Auditor.

I hereby certify that the articles or services above specified have been received in good condition or properly performed, and that the quantity and quality thereof have been verified with the exceptions noted on the margin.

_____ Inspector.

TO BE SIGNED BY INSPECTOR BY WHOM GOODS WERE INSPECTED AND RETURNED AT ONCE TO PURCHASING OFFICE.

PLATE V. *After the order has been placed carbon copies are sent to the various departments indicated at the top of each sheet. Each record is on a sheet of different color.*

On a card, Plate VII, is recorded complete information in regard to each commodity as it is purchased. The card as shown is self-explanatory. These are filed under commodity classifications. Thus when the water works department makes a requisition for valves of certain specifications it is a matter of but a moment's time to refer to this card index and determine all the facts in regard to past purchases of a similar ar-

Form 11-3. 2000

June 7 1917

Sir:

Please take notice that the supplies described below were received on this date.

Respectfully,

Signature _____

Title _____

Dept. _____ Boro _____

Receiving Point And Location: Plum St. yards.

General Description of Supplies: 17 Bales of Hay V
71 Sacks of Oats V

Order No. 7070 7030

Name of Claimant: August Ferger Co.

Contract (Yes or No) _____

Total Approximate Cost of this Delivery: OK.

For Inspection Department only.

RECEIVED 6/27/17 REFERRED _____

TO WHOM REFERRED Riggott.

PLATE VI. *A post card similar to this advises the inspector that goods have been received and await his inspection.*

ticle. At the time bids are opened the cards showing similar purchases are placed before the purchasing agent and he can at once compare the bids with those of the past, and determine whether or not it is advisable to accept the one before him, or call for bids again.

This record has also been valuable in determining the advisability of entering into continuing agreements. A full knowledge of the needs of any one department or departments for certain articles during the course of a year, enables the purchasing department to forecast the demand for a long period. As a result, when it is known that some thirty departments use in the course of a year a total of so many reams of letter paper, the agent saves the city large amounts by purchasing such supplies in quantities and entering into an agreement for the supplying of future needs at certain unit prices. Without such a card index a knowledge of the demand for anyone class of goods would be impossible.

As will be noted, this card bears the purchasing department order number. This number then makes it possible to refer to all correspondence, invoices, etc., which have entered into this particular transaction. All of these data are then filed in a 9-inch by 12-inch envelope bearing the purchasing department order number.

A warehouse has been established in the basement of the City Hall, in which a large supply of staple articles is constantly carried. The articles placed in stock are such as are in frequent demand by many departments, and which have hitherto been requistioned in small amounts. The net savings on such goods as are now placed in the warehouse and purchased in large quantities ranges from 20 to 35 per cent.

Aside from the purchase of supplies by a systematic method and in open competition, a large portion of the savings effected has been by means of standardization and the adoption of carefully drawn specifications which determine the quality in a very definite manner and leave little chance for a ven-

_____ DEPARTMENT Symbol No. _____

MATERIAL _____ Card _____

DATE	ORDER NO.	REQ. NO.	FROM WHOM PURCHASED	QUANTITY PURCHASED	QUANTITY DELIVERED	PRICE	AMOUNT OF INVOICE	DATE OF INV.

PLATE VII. *Upon this card is recorded information in regard to each purchase. The cards are filed according to commodity classifications. This is the most important file in the agent's office, and the one about which the entire system revolves.*

dor to misunderstand just what it is necessary to supply. For instance where oil is purchased it must conform to certain tests as applied by the standardizing department, and coal is bought on the basis of the number of B. t. u.'s. An article well known by its trade mark has not the least preference over another not so well known in event the latter can be purchased at a lower price and in conformity with the specifications set for that particular commodity. The work of the standardizing department has resulted in the purchase of fewer kinds of articles and these bought in combination for all institutions and departments. By following this plan it is often possible to buy from manufacturers direct, thus obviating the payment of intermediate profits.

COST AND VALUE OF ROAD MATERIALS

The deputy state engineer of Minnesota, John H. Mullen, has made a comparison of the value and cost of roads of various materials suited to the conditions in his state, which shows the following results per mile of road:

Good Earth of Gumbo Roads.

Cost of transportation, 20 cents a ton mile.

Average first cost, $700.

Maintenance, $25 per year.

Total cost for 15 years, $1,075.

Suitable for light traffic on branch roads when proper system of maintenance is provided, but will not stand motor vehicle traffic.

Gravel Roads.

Cost of transportation, 15 cents per ton mile.

Average first cost including grading, $1,400.

Maintenance, $50 per year.

Total cost for 15 years with two resurfacings at $800 each, $3,000.

Suitable for heavy team and light motor vehicle traffic.

Macadam Roads.

Cost of transportation, 12 cents per ton mile.

Average first cost including grading, $4,000.

Maintenance, $50 a year.

Total cost for 15 years with one resurfacing at $1,200, $6,000.

Suitable for same traffic as gravel.

Concrete Roads.

Cost of transportation, 5 cents per ton mile.

Average first cost for single track roadway with gravel shoulders, including grading, $7,000.

Maintenance, $20 a year.

Total cost for 15 years, $10,000.

Suitable for all classes of traffic and especially for rapid or heavy motor vehicles and heavy team traffic. Will develop intensive dairy and truck farming and greatly increased traffic.

Where present or future traffic is continuous in both directions the pavement should be double track width, would cost $10,000 per mile and would have practically no maintenance charge in 15 years' wear.

Brick is equally good for such roads but under present conditions in Minnesota is prohibitive in price.

A bituminous wearing surface ⅜-inch thick, applied to the concrete, renders the pavement softer to traffic and removes the glare of the white concrete to some extent. It costs about 10 cents per square yard and must be renewed as it wears out with frequency depending largely on the amount of traffic.

SEWAGE PURIFICATION
at
ATLANTA, GA.

The results of tests conducted over a period of six months on the largest installation of Imhoff tanks in America show that this system has met with the expectations of the engineers. A review of the method of operation shows the principal difficulties encountered and the ways in which they were overcome.

ONE of the sewage purification plants at Atlanta, Ga., has now been in operation long enough to give some indication of its efficiency and character and its effect upon the surrounding country.

The city of Atlanta is built upon a rather broken area having three principal creeks which drain it. The distance to the Chattahoochie river, into which they all discharge, and the small dilution which they give to the sewage, require purification and it is more satisfactory to put a purification plant upon each creek than to attempt a combination of them all in one plant. Some five smaller areas in the city will have their sewage pumped into one or the other of the systems designed, when the construction has proceeded to the proper point according to the plans.

The first of the three purification plants to be completed is that for the Proctor Creek district, which has a rated capacity of 3,000,000 gallons a day. The experience gained in this plant may cause some changes in the details of other plants altho all three contracts for construction were let by March, 1911, and the Peachtree Creek plant, with capacity of 8,000,000 gallons a day, is nearly completed. The Intrenchment Creek plant is not so far advanced. Its capacity is 5,000,000 gallons a day.

Each plant will receive the sewage to be treated thru an intercepting sewer two to four miles long which takes the ordinary flow of sewage from the collecting sewer mains and carries it to its purification plant, leaving storm water to continue its way untreated down the creek to the river. Each intercepting sewer can carry an amount of mixed storm water and sewage which is three times the amount of sewage alone. The purification plants will take care of a flow of mixed storm water and sewage equal to double the flow of sewage alone. On the occasions when the flow thru the intercepting sewer exceeds double the sewage flow a by-pass takes the excess into the creek without passing thru the tanks.

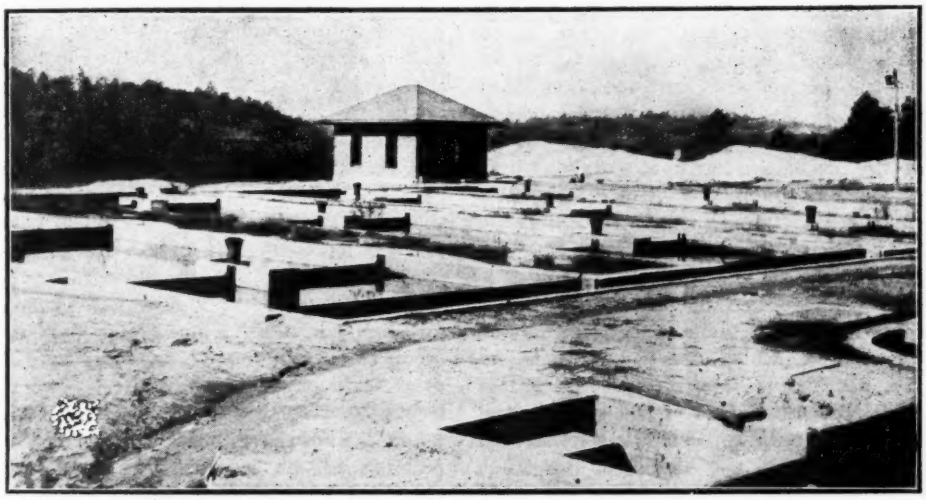
The Proctor Creek plant has been in operation for about one year and the accompanying tables of results, which are averages for each of the first six months of 1913, give a fair idea of the ability of the plant to purify the sewage. Some slight changes have been made in the

plant as the result of the experiments in beginning their operation, which are included in the following description.

The sewage in the Proctor Creek plant is somewhat more concentrated than is usual for, in addition to the sewage from the population for which it was designed, it is taking care of the night soil from some 20,000 to 30,000 additional population. This night soil is collected regularly from a section of the city which has no sewers and is dumped into the main sewer of the Proctor Creek district thru a special connection made for that purpose at the garbage disposal plant near the Railway Terminal station. It is thus thoroly mixed with the sewage and materially increases the organic matter contained in it.

Many streets in Atlanta are not paved and there is much coarse sand in the soil. A large amount of this sand finds its way thru the intercepter, especially after rain storms, and it was necessary to add a sand pit, thru which the sewage passes on its way to the grit chambers of the original plan. This sand pit can be flushed out, whereas the grit chambers must be emptied by hand, and the sand pit is therefore a great convenience at times. A coarse screen stops large floating matters which would clog the chambers or tanks.

The grit chamber is in three sections which can be used together, in pairs, singly, or by-passed entirely, according to the necessities. The drains at the bottoms of the sections are covered with coarse broken stone so that they will not be disturbed unintentionally when the collected sand is shoveled out. The grit chambers are emptied of sand about once in six days.



I. ATLANTA *Sewage Disposal Plant. Parts of sand trap and grit chamber show in lower right-hand corner. Imhoff tanks in center, with screen and head house at rear corner, distributing sewage to filters beyond on the left.*

A small part of the sand pit and the rounded corner of the by-pass of the grit chamber are seen in the right foreground of the first of the accompanying photographs.

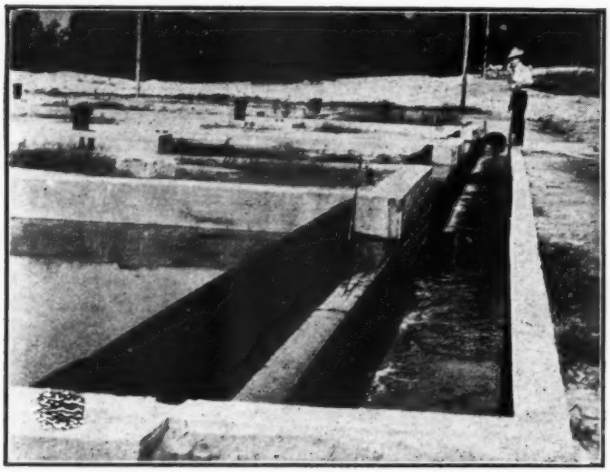
From the grit chamber the sewage flows into the inlet conduits which surround the area containing the twelve Imhoff or preliminary settling tanks on three sides, with one flowing across the middle of the area. From these inlet conduits the sewage can be fed to the four sets of tanks of three each from either end. Should the sewage be fed into one end only the first tank in the set would receive most of the sludge, and the middle tank nearly all the remainder, but by feeding the sewage alternately into each end the three tanks receive nearly equal amounts of sludge and all

three tanks of a set are thus ready for sludge discharge at the same time. This aids in securing uniform results. The flow is reversed about once in three weeks.

The sludge which settles from the sewage in the tanks slides down the inclined bottoms of the tanks and thru a long opening between these inclined bottom slopes into the sludge tank below. The water in the tanks is thus clarified and but little floating matter or growth of organic matter is seen in it, under ordinary circumstances. Flush and scum boards prevent such matter flowing out of the tanks, the clarified sewage flowing over the weirs into the outlet channel as shown in the second of the accompanying photographs, which also shows enough of the water in a tank behind a scum board to indicate the ordinary condition of the sewage in the tanks.

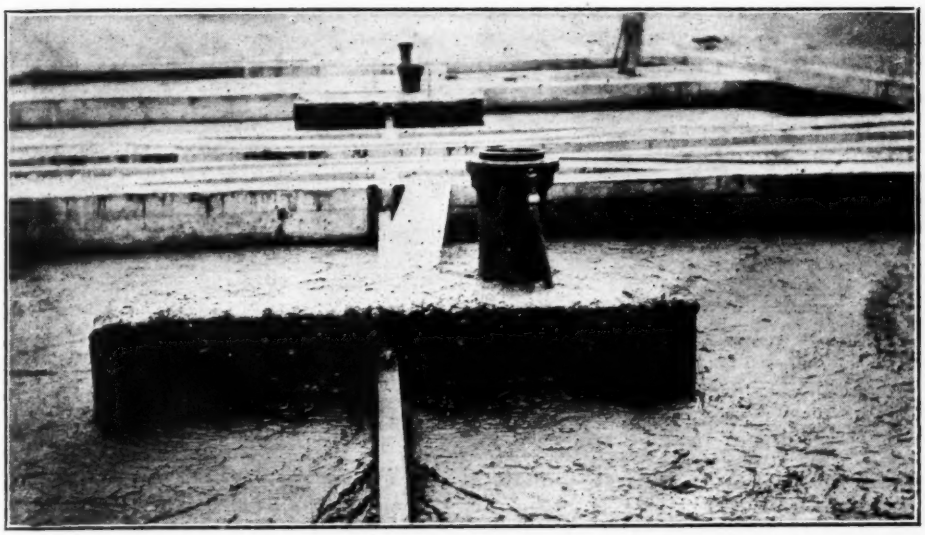
The sludge decomposes in the sludge tank under the inclined bottoms of the upper tank, which are so set that any gas which forms in the process passes up on the under side of the inclines and out thru the ventilating boxes which project up thru the centers of the tanks as shown in the first photograph; and also thru the lens shaped openings outside the tanks at the middle of each side, one of which is seen on the left edge of the first photograph.

The thick scum which forms on the surface of a septic tank is also in evidence in these sludge tanks and appears in the ventilating openings above described, becoming at times quite solid. A peculiar phenomenon has occurred several times in the Proctor Creek tanks, the reason for which has not been definitely determined as yet. The mass in a sludge tank suddenly begins to foam and run out thru the ventilating boxes; the peculiar, semi-liquid sludge boiling up over the sides of the boxes and running out over the ground or over the water in the upper tank. The third of the accompanying photographs shows the effect of this effervescence. The iron pipe, which is the top of the sludge discharge pipe, projects up thru the ventilating box and the sludge has foamed up around it, has run down over the concrete sides of the box and has spread over the surface of the water. It has been suggested that a high percentage of fat in the sewage may have something to do with this phenomenon, the fat in the sludge sometimes running as high as 11 per cent., as shown in the table of sludge analyses. This has not been demonstrated, however. Drawing off sludge from the pit below will stop the foaming, but no other method of stopping it and no method of preventing it has been devised.



II. CHANNEL *at rear of Imhoff tanks, serving to carry sewage to the tanks or by reversal, with stop planks to carry the effluent to the screen and head house, as here operating. The clear water in the settling tank is seen behind the scum board in the left foreground.*

The sludge is drawn off by means of a sludge pipe connected with the vertical sludge pipes of each sludge pit, shown in the photographs. This connection is below the level of the water in the tanks, so that the sludge is forced out by the head of water in the tanks. To prevent sticking of the sludge to the conical bot-



III. THE SLUDGE *in the digesting tank below has foamed up and over out of the openings from that tank to the air, and is spreading over the water in the upper tanks and over the ground. This action is stopped by drawing off the sludge from below.*

toms of the sludge tanks, a lead water pipe is run round each of them about 5 feet above the point of the cone, with one-eighth-inch holes. When water is let into this pipe it softens the sludge next to the concrete surface and permits it to slide down to the bottom. Here it flows into the bellmouth at the bottom of the sludge pipe and is forced up it and out into the discharge pipe. It is further aided by a stream of water from another lead water pipe which discharges upward into the bell mouth of the sludge pipe and both softens the sludge and aids in forcing it up to the discharge pipe. After the discharge of sludge fire hose is connected to the projecting tops of the sludge pipes and all the sludge in them is forced back until they are clear.

The sludge discharge pipe carries this partly liquified sludge to the sludge bed seen in the fourth photograph.

This bed is about 45 by 215 feet, is level, and has a bottom of broken stone covered with sand. The divisions seen in it are made with boards, set so that each discharge from a set of tanks will fill one section some 7 to 10 inches deep. The sludge is practically odorless, soon loses much of the 85 to 90 per cent. of water mixed with it and, if it does not rain, soon dries out enough to be handled. It is then only an inch or two thick, is scraped up by shovels and put into cars on the two little railways running over the bed, and can then be deposited anywhere it is needed. Thus far much of the sludge has been used in forming a soil for the grass which has been sown upon the new fills about the tanks and buildings. These fills are of sand so that there is plenty of use for the sludge for some time.

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A MOVABLE *roof for the sludge bed has been suggested.*

The end of each branch for discharging the sludge onto the sections of the bed is seen in each little concrete wall in the photograph of the bed, of which there are five on each side of the bed.

Where rains are frequent and evaporation is slow, a movable roof in sections has been suggested for the sludge bed. This roof can be run on rails and anchored to the supports so that it will

not be blown away, and it can be kept off the beds except when rain is actually falling. Where sludge drying area is limited and high priced, the roof may be found economical.

Sludge has been run into the low ground beyond the sludge and filter beds seen in the fourth photograph, where it drained and dried on the sandy soil, which was not specially prepared for it. This is done occasionally when convenient.

The prominent claim for the Imhoff tank is the innocuous nature of the sludge from it. The Proctor Creek plant furnishes a demonstration of the validity of this claim.

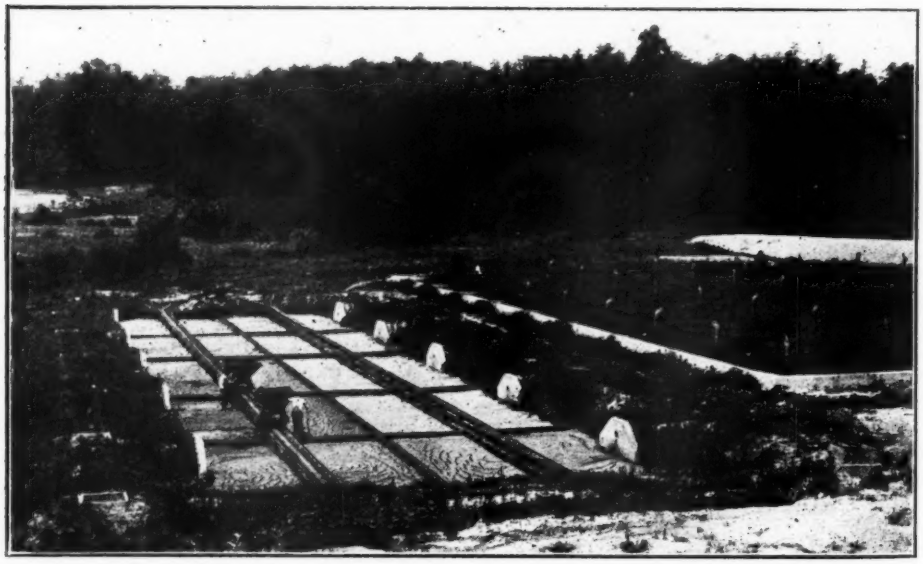
The clarified sewage which has passed thru the settling tanks flows to the gate house at one corner of the set of tanks, the location and size of which are shown in the first photograph. Here it passes thru a screen to remove any materials large enough to endanger clogging of the sprinklers by which the clarified sewage is distributed over the filter beds.

This screen is a revolving drum screen of the Weand type but at the stage of the purification process at which it is used, it is not necessary to revolve it, the amount of material to be caught by it being very small. A considerable part of the deposit on the screen seems to be greasy in its nature, forming a thin slimy film which sticks to the screen. There being no source of heat about the sewage disposal plant, it is very difficult to clean the screen of this film. The sewage is run thru the stationary screen, and there is little complaint of stoppage of the sprinkler heads of the filter bed.

The Peachtree and Intrenchment Creek plants were provided with roughing filters instead of revolving screen. Their efficiency is yet to be tested.

From the screen the sewage is discharged into the dosing tanks for automatic intermittent discharge to the two filter areas, one with an area of one acre and the other of one-half acre with space adjoining sufficient to increase it to one acre when demanded.

The sprinklers start under a head of 9 feet and the dosing tank is emptied at 2.5 feet head, and each discharge is counted automatically, so that the

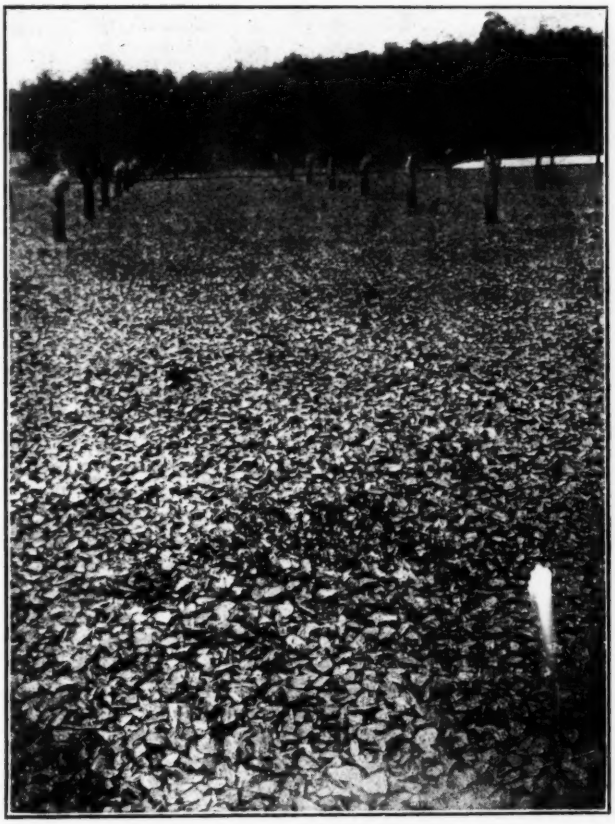


IV. SLUDGE BED. *The semi-liquid sludge is run by gravity from the Imhoff tanks thru the pipes whose ends are seen in the small concrete end walls, of which there are five on each side of the bed. Each discharge from one of these pipes is enough to fill one of the divisions of the bed 7 to 10 inches deep. After drying the sludge is shoveled into the little cars running on the railways over the bed.*

amount of sewage put thru the filters is known almost exactly.

The fifth photograph shows a closer view of the surface of the broken stone filter than can be seen in the fourth. The sprinkler heads can be seen projecting slightly above the stone, and the ventilators which run with the cowls moving with the wind are seen in the background.

When the sprinklers, of the Taylor type, are operated under full head, there is some overlapping of the sprays and recently some ponding of sewage upon the surface has been observed, occurring mainly where this overlapping occurs. This gathering of water does not indicate stoppage of the filter bed further than a small depth near the surface, for a very slight stirring of the surface stones causes the water to disappear.



V. THE SURFACE *of the contact filter bed filled with broken granite. The sprinkler heads which distribute the tank effluent over the surface of the filter are seen at the level of the surface of the bed. The ventilating pipes from the bottom of the bed, with their wind cowls, are the most prominent feature of the view.*

The valves on the service pipes to the sprinklers have been partly closed so as to reduce the maximum head on them and the overlapping areas are given a rest. The areas nearer the sprinkler head centers thus receive a greater supply. Before this results in ponding it is expected that the sluggish areas will have renewed themselves and be ready for full operation again. The throttling of the discharge causes slower discharge from the dosing tank and reduces the time between doses. This can be relieved somewhat by adjusting the levels of discharge in the dosing tanks. Altho a definite reason for the ponding has not been assigned, it is hoped that the occasional variation in pressure at the sprinkler heads and consequent change in spread of the sprays will keep the beds in good working order.

A chemist is in constant attendance upon the plant, makes frequent analyses of the sewage and the effluents, modifies the operation of the plant as required, and keeps daily records of the results of his work. The accompanying tables give the averages of these daily analyses for each of the first six months of the present year and show the efficiency of the plant since it has been in full permanent working order. We are indebted to W. A. Hansell, Jr., the assistant chief of construction of the city of Atlanta, for facilities and information furnished and to Charles C. Hommon, the chemist in charge for the tables of results of analyses.

RESULTS OF OPERATION OF SEWAGE DISPOSAL PLANT AT ATLANTA, GA.

Chemical Analyses of Sewage and Effluents from Settling Tanks and Filters—Monthly Averages of Daily Analyses—Parts per Million.

	Jan.	Feb.	1913. Mar.	Apr.	May.	June.
SEWAGE.						
NITROGEN as						
Organic	13.6	14.7	10.3	11.1	10.7	11.3
Free ammonia	18.3	19.5	16.6	16.8	17.8	21.1
Nitrites	0.1	0.1	0.1	....	....	....
Nitrates	2.1	2.5	3.0	2.6	2.3	1.6
Oxygen consumed	...	....	80.9	90.0	....	....
SUSPENDED MATTER.						
Total	303	213	219	269	280	267
Volatile	146	99	...	...	...	...
Fixed	157	112	...	...	...	...
Dissolved oxygen	4.3	4.6	3.8	1.9	2.1	1.6
EFFLUENT FROM IMHOFF TANKS.						
NITROGEN as						
Organic	12.5	11.5	7.0	6.5	7.4	6.7
Free ammonia	21.1	21.5	17.4	18.7	19.0	20.9
Nitrites	0.1	0.1	0.1	...	...	...
Nitrates	2.1	2.9	2.7	2.1	2.1	1.2
Oxygen consumed	...	...	61.6	59.1	...	...
SUSPENDED MATTER.						
Total	88	83	76	60	60	64
Volatile	48	41	...	...	...	...
Fixed	39	41	...	...	...	...
Dissolved oxygen	3.5	4.2	3.7	2.4	2.3	2.1
EFFLUENT FROM SPRINKLING FILTERS.						
NITROGEN as						
Organic	3.6	3.2	2.7	2.8	2.7	3.8
Free ammonia	12.2	14.4	8.3	6.3	7.0	8.5
Nitrites	0.8	0.6	0.5	...	...	...
Nitrates	6.7	7.5	9.5	9.5	8.8	7.9
Oxygen consumed	...	...	25.6	23.5	...	...
SUSPENDED MATTER.						
Total	59	54	68	41	34	51
Volatile	31	26	...	...	...	...
Fixed	28	28	...	...	...	...
Dissolved oxygen	8.1	7.3	7.1	6.3	5.4	4.5
RELATIVE STABILITY NUMBER	98	95	98	99	98	91
TEMPERATURES, DEGREES F.						
Sewage	61	60	63	66	70	74
Effluent from tanks	60	58	60	65	69	72
Effluent from filters	55	54	59	63	69	74

For January and February the numbers of bacteria per cubic centimeter of influent and effluents were counted, and determinations of volatile and fixed suspended matters were made, and for the first three months nitrites were also determined, but the value of these determinations not being equal to the trouble and expense of making them, they were discontinued. Following are the bacterial counts for January and February, 1913:

	January.	February.
IN SEWAGE.		
Total bacteria per c.c.	140,000	212,000
Red colonies per c.c.	208,000	60,000
IN EFFLUENT FROM IMHOFF TANKS.		
Total bacteria	444,000	204,000
Red colonies	106,000	85,000
IN EFFLUENT FROM FILTERS.		
Total bacteria	212,000	143,000
Red colonies	21,000	47,000

At the beginning of the operation of the plant some analyses of the sludge were made, the results of which are given in the accompanying table, each line giving the result of a separate determination and the average being in each case the average of the number of determinations actually made. At present only occasional sludge analyses are made.

SLUDGE ANALYSIS—ATLANTA SEWAGE DISPOSAL PLANT.

Specific Grav.	Per cent Moisture	Per cent Vol.	Per cent Fixed	Per cent Nitrogen	Per cent Fat
	88.7	45.0	55.0	1.16	9.76
	88.3	33.3	66.7	1.26	6.92
	79.3	28.0	72.0		7.34
1.02	87.8	38.6	61.4	1.44	6.84
1.05	84.2	42.2	57.8	1.28	6.42
1.02	87.6	39.9	60.1	1.28	5.84
1.03	87.7	35.5	64.5	1.12	4.0
1.03	90.2	37.9	62.1	1.2	7.14
1.02	86.2	38.5	61.5	1.28	11.12
	86.3	39.7	60.3	1.28	10.0
1.0	87.7	42.5	57.5		
1.01	90.0	37.1	62.9		
1.0	87.0	45.0	55.0	1.28	8.5
	87.7	44.0	56.0		
1.02*	87.05	39.1	60.9	1.25	6.11

*Averages.

WHY SOME MUNICIPAL ASPHALT PLANTS FAIL

By H. B. PULLAR, Engineering Chemist,
Detroit, Mich.

A SPECIFIC *instance is described of why one municipal asphalt plant failed to prove a success. The conditions described may easily apply to others. Mr. Pullar, who is an expert in the handling of asphalt, points the way to efficient methods of management that will make such plants more successful.*

MANY cities throughout the United States and Canada now own and operate their paving plants. A majority of these paving plants have proven to be successes but a number have been unsuccessful. It is not the intention of this paper to discuss the advisability of municipal paving plant ownership, but to show in a manner why some municipal paving plants fail to accomplish their purpose and prove to be losing ventures for the cities that own them. As facts are more interesting than theory, a short description of the methods used by one city owning a municipal paving plant may prove interesting.

This city, of about 50,000 inhabitants, situated in the Middle East, purchased a municipal paving plant and the necessary equipment for laying their own pavements, the initial capital expense amounting to about $10,000. According to the usual custom, the plant manufacturers offered the services of a so-called expert to get the plant in running order and demonstrate its economical qualities. This so-called expert, as is too often the case, was not familiar with the paving industry, and was absolutely incapable of organizing and properly running a paving plant. The city engineer, whose paving experience had been largely that of supervising the laying of brick pavements, justly became disgusted with the methods of this so-called expert and decided to operate the paving plant according to his own ideas.

Without intending to criticize unjustly the engineer and other officials in charge of this municipal asphalt plant, for, without question, they were running it to the best of their ability, the operation of this plant under the conditions was one which was bound to result in a failure for the municipal plant and which eventually would disgust the taxpayers with municipal plant ownership.

The concrete foundation was laid according to the same grades and profiles used for laying brick pavements, and was in most places rough and uneven. The laying of the foundation to such grades naturally made it necessary to put down a bituminous pavement consisting of a binder and wearing surface of between 5½ and 7 inches, which, of course, was contrary to all correct and recognized principles of sheet asphalt construction. The engineer gave as his excuse for laying foundation in such a manner, that should the sheet asphalt prove a failure then it could be easily torn up and replaced by a brick pavement.

The paving plant was in charge of an old man who had had some previous experience in plant work, but who was not familiar with the present day methods and who was certainly not running the plant in an economical way. The plant site was too small and was care-

lessly laid out, making it impossible to run the plant efficiently.

On account of there not being any satisfactory stone in the near vicinity, gravel was used for binder. It was used just as it came from the pit and contained a considerable percentage of round, smooth boulders varying in size from ½ to 2 inches in diameter. Of course, it was absolutely impossible for the binding material to hold and bind these boulders together in any way. While this unsuitable gravel was run into the mixer from one side of the plant the asphalt cement was run into the mixer in chunks from the opposite side, the melting and mixing going on simultaneously. This is contrary to the best practice and much better results could have been accomplished at a very small expense by having a separate kettle for melting the asphalt cement. After the mix had been running for what the foreman considered a satisfactory period it was dumped into wagons. By the time the last of the mix was out of the mixer the temperature was about 50 degrees higher than the first that came out, the result being that there was usally a part of the load that was either too cold or overheated.

The binder was then taken to the street and laid by an inexperienced crew (as will later be described) to a thickness of between 3 and 4 inches. After there had been laid what was considered a sufficient amount of binder, the plant was stopped and changes were made in order to run the surface mixture. No system was used in making these changes from running binder to surface mixture and there were many useless and expensive delays.

The surface mixture consisted of sand, marble dust and asphalt cement, the sand and marble dust analysing as follows:

Sand.

	Per Cent.
Passing mesh 200	0.0
Passing mesh 100	0.0
Passing mesh 80	0.5
Passing mesh 50	12.5
Passing mesh 40	14.0
Passing mesh 30	28.0
Passing mesh 20	13.5
Passing mesh 10	13.5
Passing mesh 4	20.0

Marble Dust.

	Per Cent.
Passing mesh 200	80.6
Passing mesh 100	12.4
Passing mesh 80	6.0
Passing mesh 50	1.0

¶ WEARING *surface improperly mixed, handled, and haphazardly rolled.*

The marble dust was of good quality and satisfactory for filler. The sand, which was to comprise 80 per cent. of the pavement, and which is too often considered of little importance, was very poor and unsatisfactory for high grade sheet asphalt work. As will be noted by the grading it was entirely too coarse and especially so when the heavy traffic of the street was taken into consideration. Sometimes it is necessary to make the best possible mix out of the available materials, but in this instance a suitable sand could have been obtained at a very small increase in cost. This poor quality of sand mixed with too low a per cent. of marble dust was run into the mixer at the same time as asphalt cement and, as was the case with the binder, all the materials were heated and mixed simultaneously. After the mixture had been heated for what was considered a satisfactory length of time it was dumped into wagons, the same deviation of temperature occurring during the discharge. The wearing surface after having received this improper treatment at the plant was taken to the street and carelessly laid and rolled to a thickness of between 2½ and 3½ inches.

The inefficiency exhibited by the street crew was even worse than at the plant. This crew did not contain a single man who was experienced in the laying of sheet asphalt pavements. The rakers, tampers and smoothers were merely laborers picked up in the city and knew nothing whatever about paving construction. The rollerman was inexperienced in paving work. He knew nothing at all about proper compression or the proper time to start rolling the hot material, and he considered the pavement sufficiently rolled when it looked fairly smooth. Even a

good rollerman would have had difficulty in rolling and getting the proper surface and compression to a bituminous pavement of this thickness.

Two samples taken from the pavement laid under these conditions analyzed as follows:

Sample 1.

	Per Cent.
Bitumen	8.62
Passing mesh 200	4.1
Passing mesh 100	1.4
Passing mesh 80	1.5
Passing mesh 50	14.0
Passing mesh 40	29.4
Passing mesh 30	14.6
Passing mesh 20	12.3
Passing mesh 10	10.0
Passing mesh 4	12.7

Sample 2.

	Per Cent.
Bitumen	7.4
Passing mesh 200	5.0
Passing mesh 100	2.0
Passing mesh 80	1.0
Passing mesh 50	14.4
Passing mesh 40	27.0
Passing mesh 30	10.6
Passing mesh 20	11.2
Passing mesh 10	9.8
Passing mesh 4	19.0

It might also be interesting to note that this pavement was being laid on one of the heavy traffic streets of the city and also on a street containing car tracks.

Just before the paving season closed this condition of affairs was brought to the attention of the city officials in charge and after some considerable discussion in which there was an attempted defense of the methods used, it was decided to allow an experiment to be made in laying a strip of pavement under better conditions.

¶ METHODS *used to place the plant and construction work on a more efficient basis.*

The first thing that was done was to put the work under the supervision of an experienced man thoroly familiar with the proper laying of sheet asphalt pavements. He secured a few experienced men from a near-by city and carefully watched the rest of the men and instilled into them a little pride in the work which they were doing. On account of being very near to the end of the paving season and the fact that it would have delayed the work considerably to get in more suitable materials for the binder and wearing surface, he took the materials which were on hand and proceeded to get the best results with them. The first thing that was done was to obtain an inch screen and screen out all the big stones contained in the gravel which was used for binder. This cost amounted to about 30c per cu. yd. More dust was added to the mix to stiffen it up and the percentage of bitumen was increased to properly coat and bind the mineral aggregate. Careful attention was given to the details at the plant and on the street, temperatures were controlled as much as possible, and a fairly uniform mix was obtained. A sample taken from the pavement laid under these new but improved conditions analyzed as follows:

	Per Cent.
Bitumen	10.0
Passing mesh 200	6.4
Passing mesh 100	1.0
Passing mesh 80	2.3
Passing mesh 50	2.3
Passing mesh 40	14.0
Passing mesh 30	6.3
Passing mesh 20	8.7
Passing mesh 10	10.2
Passing mesh 4	14.3

The foundation was laid to a satisfactory grade so that the pavement consisted of 1½ inches of binder and 2 inches of wearing surface. The mix was taken from the plant to the street in covered wagons where it was handled by experienced rakers and the rollerman was made to continue rolling both lengthwise and diagonally until the surface was smooth, had the required compression, and was free of marks and imperfections. Under these very adverse conditions a saving of a little over 25c per square yard was made in the wearing surface and a little over 24½c per square yard in the binder, or a total of practically 50c per square yard saved on the bituminous part of the pavement alone. Besides this there was a considerable saving made on the foundation and on the grading, of which the details were not kept.

The following table gives a comparison of the amount of material and costs of con-

struction between the work which was laid under the poor conditions existing at the municipal plant and under the adverse but improved conditions of expert supervision:

Binder Mix.

	Weight of Mix per sq. yd.	Cost per sq. yd. complete
Old conditions	400 lbs.	$0.52
Expert supervision	188 lbs	.2718

Top Mix.

	Sand per sq yd., lbs.	Dust per sq. yd., lbs.	A. C. per sq. yd., lbs.	Mix per sq. yd., lbs.
Old conditions	250	26.3	39	315.5
Expert supervision	169	21.3	18.7	209

Old conditions, cost per sq. yd. complete	$ .75
Expert supervision, cost per sq. yd. complete	.4987

While the above example of inefficiency in running a municipal plant is, of course, unusual, and, in fact, ludicrous to those familiar with the industry, it is an accurate account of the exact condition existing in this particular city. If this poorly managed department had continued to operate the plant with its inefficient organization, tax payers would be amply justified in condemning municipal plant ownership.

¶ PAVING *plants properly operated are an asset to a city, but many of them can be more economically managed than at present.*

While the above example is one instance where a municipal plant will eventually become an absolute failure, there are many other municipal plants throughout the country that are not proving to be good investments to the cities and are not being run to their maximum efficiency. There are many ways that savings could be accomplished and if these plants were put under efficient management of somebody well versed in the paving business they would be very valuable assets for the city. For instance, a municipal plant in one of the Western cities saved over $1.00 per car on every carload of sand that came into the plant by merely rearranging the material and storage space and putting in about 50 feet extension on the side track. There are many details connected with paving plants by which much money can be uselessly expended. Cramped quarters and insufficient storage room for crude materials are an expensive handicap and cities desiring to install municipal plants should be careful to give proper consideration to the location.

The most common form of municipal plant failure is the one well recognized by those connected with the industry, i. e., where the city appropriates and expends sufficient money for plant and equipment to take care of all its paving and then on account of the laws or on account of the policy of the administration can only run it a small part of each year for repair work. It is a waste of money for a city to invest in a plant having a capacity of from 1,000 to 2,000 yards of completed pavement per day and have only say 10,000 yards of repair work to be done during the entire season, and yet there are many cities owning their municipal asphalt plants where this condition prevails. In the writer's opinion no city should contemplate putting in a large municipal plant unless it expects to use that plant for at least 50,000 square yards per year. The maintenance and cost of operation for large plants are too great and the result is usually a failure. There are numerous small mixers on the market today which are satisfactory for cities who wish to do their own work amounting to only a few thousand yards per year. The initial and operating costs are small and when not in use they require practically no expense. The maintenance and depreciation are also very low.

There are many other causes for municipal paving plant failures which require long explanations, but it is at least encouraging to note that the cities owning municipal paving plants are waking up to the fact that sometimes failure can be turned into success and are putting their municipal plants under proper conditions to do the work for which they were intended.

HOUSTON'S PLAN OF TAXATION

By J. J. PASTORIZA,
Commissioner of Finance and Taxation,
Houston, Texas.

A PLAN *of taxation which puts the burden on the land, the permanent improvements and the physical appurtenances of public service corporations, according to the area they occupy. It relieves cash and personal property. It is reported to be satisfactory to 98 per cent. of the taxpayers. It would not be so satisfactory if it was not accompanied by the Somers system of determining land valuations.*

NINETY-EIGHT per cent. of the taxpayers of Houston are satisfied with, not only the Somers system, which we installed in the beginning of 1912 and which was continued for the assessment of 1913, but they are satisfied with the Houston, Tex., plan of taxation, which is an addition to the Somers system.

The Somers system is nothing more or less than a system of equalization of realty values. Under the Somers system property owners in a city indicate what they believe is the true value of a lot 50 by 100 feet in the middle each of the four sides of a block. This is mathematically reduced by dividing the sum by fifty and getting the price of one foot of land facing on the block running back 100 feet. This price is placed upon the map of the city. When this is done by the city assessor and the property owners themselves, the map is turned over to the representative of the Somers system, and by that system he calculates the value of all of the other lots in the block. This calculation insures to the owners of every other lot in the block a valuation which will result in a fair equalization of the commercial value of every lot in that block. The corner lots will be valued in proportion to the value of the property on the two adjoining streets. This system has been worked out by Mr. Somers, of New York, by taking thousands of cases of actual bona fide sales and getting at the averages.

The city of Houston, after applying the Somers system and getting the full sale value of every lot in the city and the full value of the cost of reproducing every building in the city, less depreciation occasioned by age or utility, then decided to adopt what has been since known thruout the United States as the "Houston Plan of Taxation." The Houston plan of taxation has no connection whatever with the Somers system, except that it uses the Somers system as a basis for the equalization of values of both land and buildings. The Houston plan of taxation, in a word, is as follows:

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¶ A BRIEF *summary of the fundamental principles of taxing land and franchises.*

Land to be assessed at its full value as ascertained by the Somers system; buildings or any other improvements, including machinery of manufactories, upon land, to be assessed for taxation at 25 per cent. of their reproductive cost, less depreciation. Franchises of all public service corporations to be assessed at a price which would be represented by the

value of that portion of the streets or sidewalks which are used by these public service corporations, either for the laying of tracks, the planting beneath the earth's surface of conduits, sewer or gas mains, or the installing upon the edge of sidewalks of telephone or telegraph poles.

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¶ CASH *and personal property, including household effects are not taxed. In two years assessments have increased* $33,000,000.

The Houston plan of taxation contemplates and provides for the total exemption from taxation of all cash owned by individuals or corporations deposited in the banks of Houston. In other words, there is not a dollar deposited in any bank in Houston which is taxed by the city. We have further exempted from taxation such personal property as is owned by the individual taxpayers, even including their household furniture and effects.

Notwithstanding all of these exemptions and the assessment of improvements upon land at only 25 per cent. of their cost, we find that the assessment rolls of the city show an increase in two years of $33,000,000, and the tax rate is reduced from $1.70 to $1.50 per $100 valuation. And that is not all. Owing to the equalization of values brought about by the adoption of the Somers system, we find that over 5,000 taxpayers have had their taxes reduced for the year 1912, when compared to what they paid in 1911, previous to the adoption of the Somers system.

You ask for our impression concerning this system and its practical workings. In reply I wish to state that after two years' trial I find that the plan of taxation having been approved by the previous administration and having been endorsed by this administration is satisfactory to over 98 per cent. of the taxpayers. The reason why it is so satisfactory is that the taxpayers realize that, no matter how powerful or influential a property holder may be, he cannot get his real estate assessed at a less value than his neighbors, because this office has shown the taxpayer how to calculate the value according to the Somers system and he himself can discover whether there has been any favoritism shown or not.

The property owner whose taxes have been increased is satisfied, because he does not in the future have to worry as to whether his neighbor or competitor is getting his property in for taxation at a less per cent. than he is.

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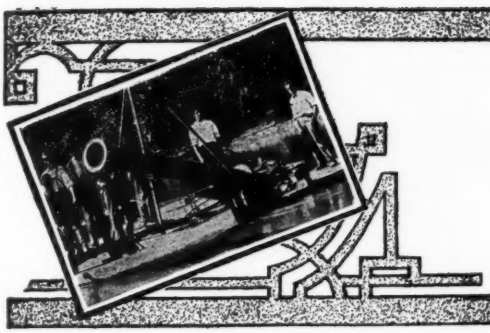
¶ THE SYSTEM *has apparently been permanently established, and can only be changed by a referendum vote of the taxpayers.*

This plan was adopted by the former administration upon my recommendation, and the present administration has also approved of it, so that it appears to the writer that the system has been established permanently, to be changed only by a referendum vote of the people themselves. We are adding to our charter a provision adopting the initiative, referendum and recall, which places within the hands of the people the right to change any law which the city council has seen fit to adopt. As far as the writer is concerned, while I may be wedded to the system, if a majority of the people should decide to change it, I would work under the change suggested by them.



EDITORIAL

FIRE PROTECTION.

Motor driven fire apparatus is a comparatively recent innovation and, until recently, it has not been possible to determine the true efficiency of this type of equipment. Reductions in fire losses due to the quicker and more efficient service resulting from motor driven installations have also been largely a matter of conjecture. The figures given in the article in this issue by H. W. Perry represent a thoroughly practical and reliable summary of results and the remarkable saving he records should serve to arouse the instant attention and interest of every city official. It is to be expected, also, that much additional information on the efficiency of motor driven fire fighting machines will be brought to light at the forthcoming convention of the International Association of Fire Engineers, to be held in New York City, September 1 to 6. Every city, large or small, should have one or more representatives at this convention.

EFFICIENT GOVERNMENT.

Many cities of the United States would gain much by turning their attention to Cincinnati. From a community ridden with bossism, known nationally as a city in the grasp of a powerful machine which collected its spoils unmolested for many years, it has emerged under the leadership of a fearless, fighting young lawyer to be one of the foremost examples of what it is possible to accomplish in the way of efficient government. Mayor Hunt has been in office for but two years. In that period he has put under headway a movement which by the very breadth of its principles will continue to gather momentum which a change in political temper will not be capable of stemming.

Efficiency has been his keynote from the day he stepped into office. He has gathered about him men who have been willing and enthusiastic to place their city on a higher plane. The inauguration of an "Efficiency Bureau" has been one of his big accomplishments. The men on this board have been untiring in their efforts. The Bureau has already co-operated

with the Street Cleaning Department, the City Hospital, the Waterworks Department and so forth and their records show that they have determined the exact cost of conducting their work. Today a foreman must get a standard amount of work from his gang or he is investigated.

The Purchasing Department, described elsewhere in this number, has been made a valuable asset in the city management and is saving it many thousands of dollars.

The influence of such a regime is evident on all sides. Passing thru various departments of the City Hall one is much impressed with the snappy, vigorous manner with which each clerk and executive is conducting his every day work. Quite a contrast to the sleepy, let-it-go-until-tomorrow atmosphere of many City Halls.

Results have been accomplished in Cincinnati in but two years. In order that this efficient mayor can continue to pull his city up the grade of reform he must now roll up his sleeves and fight for his re-election. The term is too short for a capable executive. Therein lies one of the great weaknesses of many American cities. Longer terms, protected by the recall, would insure cities as fortunate as Cincinnati a continuance of efficient government.

THE CITY AS A BUSINESS PROPOSITION.

The Dayton, Ohio, charter, an abstract of which is given on another page, is the latest well-considered and detailed effort to apply business principles and home-rule to city affairs. It treats the city as a business corporation, with the addition of the checks necessary because the business success cannot be measured by the profits. A good form of government does not insure good government unless the people demand it, but makes that result easier. Dayton's progress will be watched with the utmost interest by all advocates of economy and efficiency in public business.

CLEARANCE BETWEEN CAR TRACKS.

We still hear of serious accidents and deaths resulting from pedestrians being caught between two passing street cars. Usually such accidents occur in cities where no uniform practice as to clearance has been adopted, where, on some streets a person can easily stand unmolested between passing cars, and on others would be crushed to death. Every city should require that the clearance on all streets be the same—preferably so slight that no one would be tempted to run the risk of standing between cars.

QUESTION DEPARTMENT

Records for the City Engineer's Office

I understand that you have published articles on city engineer's office records. I am working up a system of records and would like to gather some data on how it is done.

B., City Engineer, ———, Ind.

A general list of the articles in MUNICIPAL ENGINEERING on the subject will be found in vol. xlii, p. 253. Those of most direct practical application are probably the following:

A review of the annual report of the city engineer of Salt Lake City for 1908, in vol. xxxviii, p. 56, gives an outline of the classification of accounts and records. The report, including the full schedule co-ordinating all the departments in the city engineer's office, can probably be obtained from the present incumbent. This is the most practical system of records which has been described in much detail in a printed report. Some of the forms of the loose leaf system used in the departments are reproduced in vol. xxx, p. 409.

A general description of a method of filing and indexing city engineer's records is given in vol. xxx, p. 270, based on the system in use in the office of the city engineer of Indianapolis, which has never been described in detail and is not so elaborate as that in use in Salt Lake City, tho thoroly practical.

Some special forms are given in articles or "Form of Grade Book for Small City," vol. xl, p. 210, giving a description of the form used; on "Record of City Improvements," vol. xl, p. 222, giving a reproduction of the blank used and an entry thereon; "Handling Day Labor in Holyoke, Mass.," vol. xxxviii, p. 202, reproducing a blank properly filled; on "Forms for Daily Force and Material Reports," vol. xxxviii, p. 270, reproducing the form and giving some criticisms of its contents; "Control of Workmanship on Asphalt Pavements," vol. xxxvii, p. 301, giving the forms of reports to the asphalt pavement inspector and chemist to enable him to know what is being done; on "A Daily Report Form for Street Work," vol. xxxiv, p. 239, for use when the work is done on day labor account for the city. All but three of these are for use on day labor jobs.

How to Separate the Fiber from Vegetable Tissue

I want to decompose some soft vegetable tissue or plant growth to obtain a fiber out of the plant, and want to find a cheap chemical to do this in a cold solution or in a hot one with several hours' boiling if need be. I have an idea that some method similar to that used in the manufacture of wood pulp would answer in my case. Can you tell me where to get full information about making up wood pulp, what chemicals are used, how to cook the pulp and under what pressure? I might use some of the same machinery.

B., ———, Fla.

There are several processes of treating wood pulp, which may be roughly classed as the sulphite, alkali and sulphate processes. Descriptions of them will be found in such books as Beveridge's "Papermaker's Pocketbook," ($4); Watt's "Paper-Making" ($3); Clapperton's "Paper-Making" ($2.50); Cross and Bevan's "Text Book on Paper Making" ($5). Good general descriptions will be found also in the large encyclopedias of recent publication.

Manufacturers of machinery for use in the various processes are Dilts Machine Works, Fulton, N. Y.; Olin Scott, Bennington, Vt.; Werner & Pfleiderer, Saginaw, Mich.; Waterville Iron Works, Waterville, Me., and many others.

Each vegetable fiber requires a process of its own, differing in detail or possibly as a whole from any other and there are many patents on machinery for dry and wet mechanical separation of fibers, for treatment by alkaline, electrolytic, acid and other methods. A new fiber would

require special study and experiment by an expert to determine with the least expenditure of money whether it could be treated and what process would be best, and the details must be worked out experimentally. The following description derived from the claims in patent 1,001,284, issued to Kreissl and Seibert of Vienna, shows some of the variations which may be made in a process in order to produce the best results:

"The process for obtaining textile fibers from vegetable material, such as nettles, hops, sunflower stalks and the like, which consists in softening and externally purifying the material by a preliminary boiling, then treating the material in an autoclave boiler with a diluted soda lye of 2 to 8 per cent. strength for about 5 minutes under a pressure of about 15 atmospheres, whereby the ligneous parts of the stems are completely destroyed, and then apply jets of water under pressure to the mass, whereby the fibrous material is obtained without requiring a mechanical removal of the bast, boiling the fibrous material again in a soda lye having a strength of about 8 per cent. for 3 minutes under a pressure of 10 atmospheres, again applying jets of water to the mass, placing the fibrous material in a bleaching solution, then immersing the fibrous material for a short time in a very diluted sulphuric acid, washing and drying the fibers and then treating the fibers with vapors of glycerin for a short time, whereby they are rendered flexible and smooth. The above process may be preceded by 24 hours treatment in cold lye water. The bleaching solution may be a solution of common salt subjected to electrolysis. The dilution of sulfuric acid, is 1 kilogram of acid to 100 liters of water."

Any of the bi-monthly volumes of the *Patent Office Gazette* contain descriptions of newly patented processes and machinery for treating and separating vegeable fibers for further use.

The advice of a chemist expert in the treatment of fibers will save much time, trouble and expense.

Pumping Equipment of Municipal Water Purification Plant, Grand Rapids, Mich.

Do I understand that entire pumping equipment of Grand Rapids, Mich., water purification plant, as described in your issue of June, 1913, was furnished by the Fort Wayne Electric Works, Fort Wayne, Indiana? I would also appreciate descriptive items with rated capacity and expenditures.

E. D. STRAUDHAUSSEN,
New Orleans, La.

In April, 1910, the city of Grand Rapids by vote authorized a bond issue of $400,000 to pay for the new water works project, and of this amount, $350,000 was to be used for the filtration plant proper and $50,000 for conduits and some additional machinery to be installed in the high-lift pumping station. The work of constructing the filtration plant was divided into four separate contracts.

Contract for the furnishing and installing of all pumping machinery on above plant was awarded to the Fort Wayne Electric Works, Ft. Wayne, Ind.

Under Item No. 1 were furnished three pumps, rated 5,600 gallons per minute with 26-foot head, 690 r.p.m., efficiency 68 per cent., 15-inch discharge, 15 to 18-inch suction, net weight complete with bearings, shafting, etc., 4,800 pounds. These pumps are direct coupled to Fort Wayne M-10-60-720, form RX, 440-v., 2-phase, vertical induction motors. These pumps are also rated 4,000 gallons per minute, 30-foot head, 64 per cent. efficiency; and 7,500 gallons per minute, 15-foot head, 48 per cent. efficiency.

Under item No. 2 were furnished two pumps rated 2,900 gallons per minute, 26-foot head, 850 r.p.m., efficiency 66 per cent., 10-inch discharge, 10 to 12-inch suction, net weight of pump with accessories, 2,600 pounds. These pumps are direct connected to Fort Wayne M-8-30-900, form RX, 440-v., 2-phase, vertical motors. Pumps are also rated 2,100 gallons per minute, 30-foot head, 62 per cent. efficiency; and 3,900 gallons per minute, 15-foot head, 46 per cent. efficiency.

Under item No. 3 there were furnished two pumps rated 1,000 gallons per minute, 38-foot head, 850 r.p.m., efficiency 60 per cent., 6-inch discharge, 6 to 8-inch suction, net weight of pump and accessories, 1,500 pounds. These pumps are direct coupled to Fort Wayne M-8-20-900, form RX, 440-v., 2-phase, vertical induction motors. They are also rated 400 gallons per minute, 52-foot head, 42 per cent. efficiency; and 1,300 gallons per minute, 29-foot head, 52 per cent. efficiency.

Under item No. 4 was furnished a sump pump rated 180 gallons per minute, 15-foot head at 850 r.p.m., 40 per cent. efficiency, 3-inch discharge, 3 to 4-inch suction, net weight of pump and accessories, 950 pounds. This pump is coupled to a Fort Wayne MA-8-2-900, form C, 440-v., 2-phase, vertical induction motor. Motors under items 1 and 2 pump water from the Grand River and operate both continuously and intermittently. Pumps under item 3 pump clear well water intermittently. The sump pump under item 4 takes drainage water from a sump in pump pit and delivers it to drain. The casings of all pumps are heavy cast iron with feet cast on same.

The impellers for pumps under items 1 and 2 are cast iron, for items 3 and 4, bronze. All pumps are equipped with ball thrust bearings.

The annual expenditures on construction of pumping station and installation of machinery are as follows:

	1909-10	1910-11	1911-12	Total
Pumping engine, etc	$37,849.02	$27,102.01	$6,103.13	$71,054.16
Boilers and foundation	486.41	17,948.17	4,299.57	22,734.15
Crane and crane railway	.....	.....	3,765.02	3,765.02
Stokers	70.05	3,873.01	1,851.08	5,794.14
Brick stack	9,153.56	.....	.....	9,153.56
Underground flue	2,939.23	632.56	257.04	3,828.83
Ash tunnel	.....	1,541.79	261.76	1,803.55
Pumping station and shops	31,372.67	62,571.75	14,860.41	108,804.83
Boiler house	20.09	17,147.52	3,457.55	20,625.16
Temporary buildings	193.76	500.86	.....	694.62
Heater and purifier	.....	611.83	661.20	1,273.03
Steam header	.....	16,271.01	13,960.83	30,231.84
Generators and motors	.....	343.08	6,442.57	6,785.65
Shop machinery	.....	941.04	40.50	981.54
Shop heating and plumbing	.....	1,782.76	152.39	1,935.15
Station heating and plumbing	.....	1,483.76	933.24	2,417.00
Station floors	.....	15.42	3,566.15	3,581.57
Real estate	.....	4,000.00	.....	4,000.00
Sidewalks and pavement	.....	.....	1,208.50	1,208.50
Wiring, station and shops	.....	.....	1,231.74	1,231.74
Stables	.....	.....	3,906.87	3,906.87
Condenser, exhausts, etc	.....	.....	6,326.82	6,326.82
Totals	$82,084.79	$156,766.57	$73,286.37	$312,137.73

Wire-Cut-Lug Brick—Vitrified Sectional Sewers

I wish full information and prices on wire-cut-lug brick from reliable firms. Also some information on the subject of vitrified sectional sewers.

M. F., ———, Ill.

The wire-cut-lug-block has increased in popularity so rapidly that over half the brick sold in 1912 by the members of the National Paving Brick Manufacturers' Association were wire-cut-lug blocks, altho less than one-third of the members of the association are licensed to make the brick.

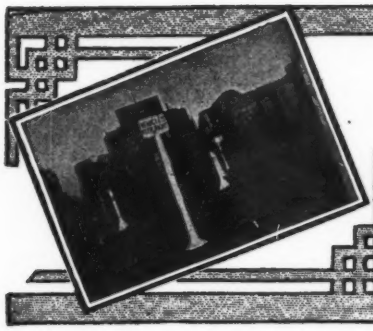
They are made now by about twenty of the leading paving brick manufacturers in New York, Pennsylvania, Ohio, Indiana and Illinois. The manufacturers in Illinois are the Danville Brick Co., Danville; Alton Brick Co., Alton; Murphysboro Paving Brick Co., Murphysboro. Those in Indiana are Clinton Paving Brick Co., Clinton; Wabash Clay Co., Veedersburg. These are all reliable firms who will give prices and full information. MUNICIPAL ENGINEERING is the best source of information about pavements built of the material and the numbers of the last year or so, since the block was put in the market, have had the latest information from month to month.

The vitrified sectional sewer is new but it seems to be good. It has been used successfully in some Indianapolis sewers built last year. The blocks are made by the American Sewer Pipe Co., Akron, Ohio. Lewis McNutt, Brazil, Ind., can also supply them.

Standard Specifications

You would oblige me greatly by letting me know where I could secure A. S. M. I. and S. P. S. standard specifications for different kinds of pavements. B., Montreal, Can.

Standard specifications of the Association for Standardizing Paving Specifications can be obtained from John B. Hittell, secretary, Street Department, Chicago, Ill., and will cost $5. The specifications of the American Society of Municipal Improvements are scattered through two or three of the annual volumes of the proceedings, but the secretary, A. P. Folwell, 50 Union Square, New York City, N. Y., can send separate copies of the specifications for asphalt, wood block and brick. The latest volume of proceedings, which costs one dollar, contains the specifications which have been adopted for concrete pavements, cement sidewalks, curb and gutter, and for sewers, which have not yet been adopted.



WORKERS IN THE FIELD

Fixed Carbon Not a Proper Test for Asphalts and Bituminous Road Binders

The Editor of MUNICIPAL ENGINEERING:

Sir—The question has often been asked by city and state engineers, as well as many producers of excellent asphalt and bituminous cements and road binders, what, if anything, has "fixed carbon test" to do with the quality of these products for pavement and road construction? The answer is that it has nothing to do with the qualities of these materials.

Fixed carbon is not a definite substance or quality in any given coal or other material. It constitutes the results of an arbitrary test of the approximate portion of coal which will remain and continue to burn and give heat after relatively light, volatile hydrocarbons have been partially burned away by flame. This test was devised solely for coal, by the committee on coal analysis of the American Chemical Society, and published in the *Journal* of the American Chemical Society, 1899, No. 21, p. 1116.

The test is made briefly as follows: One gram of coal is put on a "platinum crucible weighing twenty or thirty grams and having a tightly fitting cover. Heat over the full flame of a Bunsen burner for seven minutes. The crucible should be supported on a platinum triangle with the bottom 6 to 8 cm. above the top of the burner. The flame should be fully 20 cm. high when burning free, and the determination should be made in a place free from draughts. The upper surface of the cover should burn clear, but the under surface should remain covered with carbon."

It is therefore evident that the fixed carbon test has nothing to do with the quality or uses of asphalt, bitumens, asphalt cements and road binders. Burning and consequent destruction of the asphalt or bitumen proves nothing concerning the original condition and qualities before being burned. The qualities of the asphalt or other bitumens as used (not the burned products) are what are needed for cementing together and waterproofing the other materials in a pavement or road.

No two persons in the same or different places, with the various allowed sizes of crucibles, different sized Bunsen heaters, different kinds and pressures of gas, different lengths and sizes of flames, different distances the crucibles stand above the burner, even aside from the personal factor or difference in the way different persons work, can get the same quantity of fixed carbon (ash-free or otherwise) from the same sample of coal or other substance. When this variable process is applied to an asphalt or bituminous substance, even more widely varying and discordant results are obtained. It cannot be used as a basis of comparison of asphalt and bituminous materials, nor as a proof of their good or bad qualities.

The introduction of the fixed carbon test for coal into the asphalt industry has nothing to do with the determination of quality; nor can any minimum or maximum amount be set for this alleged test, between which all good asphalts and bitumens will come. Some good ones will be outside such limits, and some worthless asphalts and bitumens will be inside any limits attempted to be established by fixed carbon requirements. This test is sometimes used by chemists, simply as a small but imperfect indication, taken with other special chemical tests, to identify, if desired, an unknown or unnamed brand of asphalt, but has nothing to do with quality. This test should not be placed among the tests for quality of asphalt or any road building materials. The insertion of this test in any city, county, state or other specifications is purposely or unconsciously done, or caused to be done, by copying or otherwise from one or more persons or agents, who thereby seek to include some and exclude other brands of asphalts and road materials, which compete and are perfectly good for use.

The fixed carbon (coal) test should be

ignored, if still found in asphalt or bituminous specifications, and not enforced, not only on engineering, but also on legal grounds; that "the test does not apply to or establish any quality of the material necessary for the construction made or to be made;" i. e., in this case it does not apply to refined asphalt, asphalt or bituminous cement or road binder for constructing and waterproofing roads or pavements.

J. W. HOWARD, C. E.,
Consulting Engineer on Construction and Testing Roads, Streets and Pavements, New York City.

Concrete Pavement Costs

The Editor of MUNICIPAL ENGINEERING:

Sir—With good equipment and an average gang the actual cost of mixing and placing should not exceed 7 cents per square yard for 7 inches of concrete. To this should be added a cost of 3 cents per square yard for finishing and labor necessary for handling the forms, making a total for one-course work of 10 cents for mixing and placing. As has been stated, there is a slight difference in the cost of placing single and two-course work, with the advantage in favor of the former.

Placing expansion joints is such a simple operation that 1 cent per square yard should cover the cost. To this must be added the cost of metal joint and tarred felt delivered on the job, or the cost of filling the joint with a plastic filler.

In discussing the cost of concrete pavements, a few examples of actual construction will help to make clear the division of expense. The first pavement was laid recently in a small town in the central part of Illinois, totalling 5,000 square yards. The total cost of the work was $3,964.02, excluding cost of equipment, which consisted of a ⅜-yard Koehring mixer of the latest type and a 4½-h.p. gasoline engine, and also excluding the cost of the water for mixing and sprinkling. The pavement was 45 feet wide and uniformly 6 inches thick. The cost of the work was divided as follows:

Superintendence	140.00
1,457 barrels cement	1,547.15
Sand, stone and gravel	1,284.97
Labor	560.07
Lumber and forms	35.00
Bitumen and creosoted blocks for joints	48.67
Coal and oil for mixer and engine	30.75
Excavation	307.41

A summation of these figures gives the cost of this road as $4.76 per cubic yard or $0.79 per square yard.

In the west central part of Michigan 2,586 feet of concrete, 9 feet 2 inches wide and 0.55 of a foot thick, were constructed by a township as an experiment. A gang of twelve men using a 7-cubic foot side-delivery Koehring mixer did the work for a total cost of $3,392.62, divided approximately as follows:

746 barrels cement	$ 870.00
655.9 yards sand and gravel	553.28
Baker protection plates and filler	170.12
Labor	1,690.50

These figures give a cost of $7.28 per cubic yard or $1.31 per square yard. Had the cost of grading, excavation and culverts been added to the above, the cost of pavement would have been increased to $8.73 per cubic yard or $1.46 per square yard.

The following work was constructed in the north central part of Illinois during October and part of November of last year: The road is 5,500 feet long, 12 feet wide and has a uniform thickness of 6 inches. The total cost, not including water, macadam shoulders and equipment, was $7,089.42. The equipment consisted of a ½-yard Koehring mixer and road grader, plows, scrapers, road roller and the necessary wheelbarrows and shovels. The cost was as follows:

2,274 barrels cement	$2,333.65
720 yards sand	582.49
1,185 yards gravel	1,787.93
Operative cost of mixer	51.99
Baker plates and creosoted wood blocks for expansion joints	160.03
Labor	2,282.52

The total of these figures determines the cost per cubic yard as $5.80 or $0.96 per square yard. No information was obtained on the cost of water for this work.

CARL M. BOYNTON,
Inspecting Engineer Universal Portland Cement Co.

Make Your Own Blue Prints

The Editor of MUNICIPAL ENGINEERING:

Sir—We have your communication regarding the blue print machine which we have in operation, and it is with pleasure that we give the information you request.

The Pease blue print machine which we have in operation is a model for efficiency, economy and productive capacity. It is for these reasons that it was selected from among other machines, and it is serving its purpose admirably and beyond expectation. In order that its advantages may be more fully understood, the following description will be enlightening if used with the accompanying photograph.

The machine is built on a cast iron

frame about 50 inches in length, 30 in width and 60 in height. A table is attached to the operating side by means of a pair of brackets which are integral with the frame. Below the table are two steel rods ¾ inch thick, upon which the rolls of blue print paper may be placed. The paper is unrolled so that the sensitized side is uppermost on the table, where the tracing or whatever is to be copied may be laid upon it. Directly to the rear of the table is a quadri-cylindrical piece of plate glass, extending the full length of the machine, its concave side toward the operator, its lower edge parallel with and slightly above the edge of the table. A canvas belt, which is as wide as the glass, revolves about two rollers, one of which is placed at the uppermost edge of the glass and the other below the table. The bearings in which the roller runs are placed on rocker arms which are under spring tension, thus causing the canvas to bear upon every portion of the under or convex side of the glass.

PEASE *blueprinting machine, from which the National Brake and Electric Company secures an average monthly output of* 2,000 *large tracings,* 4,000 *half size, and* 10,000 *quarter size.*

The tracing having been placed upon the blue print paper, both are started into the machine.

The printing light consists of a row of five arc lamps, which are supported, parallel to the glass, upon a conduit pipe, which carries the wiring for the lamps. Each lamp is provided with a separate switch and a shield to keep the intense light from the eyes of the operator. The lights approximate 1,000 c.p. each and are so arranged that they may be tilted backward upon the table to be trimmed.

The motive power is supplied by a ¼-h.p. electric motor and is transmitted to the rollers by bevel gears. By means of a sliding gear transmission, which permits of two changes of speed, and a regulating reostat, the speed of the machine may be varied from an almost imperceptible motion to the highest speed practicable for blue printing.

The paper coming out of the top of the machine goes toward the rear and is rolled up in a sheet iron trough provided for that purpose. The tracings fall into a similar trough, which is between the operator and the arc lamps, and which may be slid up and out of the way when trimming the lamps. A fan is attached to one end of the machine to carry away the intense heat caused by the arc lamps.

The entire construction of the machine is very rigid and there is no expense of maintenance except that of replacing cracked glasses for the arc lamps and the carbons, which burn continuously for a day.

The cost of operation is low considering the speed with which tracings are printed. The large size tracings are printed in thirty seconds on fast brands of paper, and forty on the slow brands, while a new tracing which is not soiled may be printed as fast as fifteen seconds.

The printed rolls are taken from the machine and cut into lengths of about 60 inches. These are folded thru the middle and placed in a tank about 50 inches square, containing a solution of potassium bichromate. They are allowed to remain here until perfectly blue, when they are hung up and the surplus moisture is drained from them. They are then placed in a drying oven, which

consists of a sheet iron box about 4 feet high, 3 feet wide, and 5 feet long, in the bottom of which is a set of steam coils. The prints require about five minutes to dry, when they are cut to size and delivered. If a print is desired sooner than this it may be reversed and put thru the machine again, which dries it in about thirty seconds.

The average monthly output is two thousand large size tracings, four thousand half size, and ten thousand quarter size sketches, and miscellaneous drawings. Altogether about fifteen hundred yards of blue print paper are consumed.

The largest number of prints made in one day is 2,125, of which 225 were full size, 350 half size, 1,550 quarter and miscellaneous sketches and odd sizes. The department employs three young men, who graduate eventually into the drafting room. One of these operates the machine and finishes the prints, while the other two deliver them and keep account of them, also collecting all old prints which are superseded by new designs.

This machine is manufactured by the C. F. Pease Co., of Chicago.

Our blue printing department is located immediately above the drafting room to facilitate delivery of tracings and general communication. It is operated in conjunction with the photographic department and the writer has charge of both departments.

NATIONAL BRAKE & ELECTRIC CO.
F. H. COMMANDER,
Staff Photographer.

Protect the Concrete Where Work Is Suspended

The Editor of MUNICIPAL ENGINEERING:

Sir—From various causes, work on any part of a concrete structure is liable to be suspended from a couple of days to a week, or even weeks or months in some instances. A halt of this kind, in the work, is usually at some definite junction point, such as the top of a footing or abutment if it be bridge construction. The forms protect the concrete on all sides except the top, the part on which the added structure will rest. This is written as a note of warning to those builders who so carelessly leave this exposed top unprotected from the summer sun and wind.

In most instances the concrete is made wet, poured, and the forms protect the sides from immediate loss of moisture, but the exposed top may be dry almost before the final set has taken place. This drying of the surface must necessarily leave a weakened surface.

We would consider it bad practice to leave a thin layer of sand or earth between an abutment and its foundation, or the abutment and the arch which it carries, but "burned" concrete is little if any better. If it be continuous work, this weakened top can be picked off, but if this top line comes to a finished line, as it most often does, the removal of the top will disfigure the work.

The only safe way is to protect all top surfaces from sun and wind and keep them supplied with sufficient moisture for proper curing.

H. A. MARK.
Gering, Neb.

Los Angeles Needs Storm Sewers

Every heavy rain in Los Angeles is followed by a flooding of the streets that carry off the water from districts without storm sewers. The only way to get across some of the streets dry shod is to wait for an obliging driver and get a lift in his wagon. This condition led one of the councilmen of that city to propose a plan, which was successfully carried out last winter, to utilize the street sprinkling teams and drivers, which were idle during the winter, to haul portable bridges and planks and set them from the curb at the flooded crossing, anchoring them by wire to the nearest telephone post. After the storm they were collected and removed to a storage place until needed again.

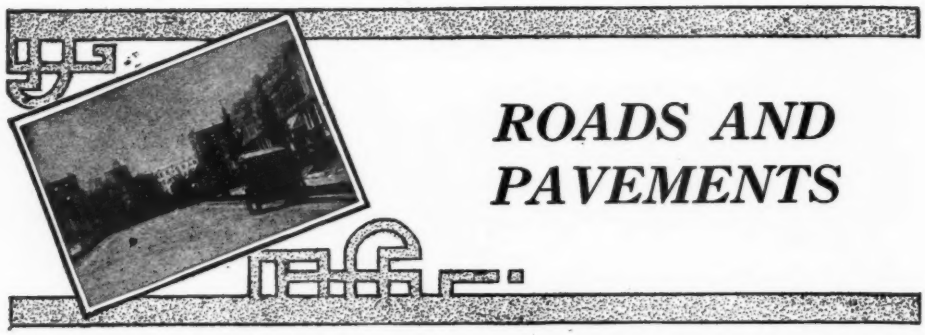
St. Paul's Paving Plan

1.—The city shall do its own work in all cases and shall not abandon that principle until the city engineer shall officially notify the board of public works that it can not do no more work.

2.—Creosoted blocks shall be the preferred pavement on all heavily traveled streets and all residential streets where th value of the property will justify the cost, and the grades are not too steep. On all steep grades sandstone shall be used.

3.—On all streets, where a cheaper pavement is required, on which there are street car tracks, brick or some other substantial lower priced pavement, other than asphaltic concrete, shall be used.

4.—On streets where there are no street car tracks and where traffic is light and the property values necessitate a cheap pavement, asphaltic concrete shall be used—the mixture to be manufactured by the commissioner of public works, under specifications devised by him and the city chemist, which will not infringe upon any patented pavement.



ROADS AND PAVEMENTS

Petrolithic Road Construction with Costs of Construction and Maintenance.

By K. F. Postle, Los Angeles, Cal.

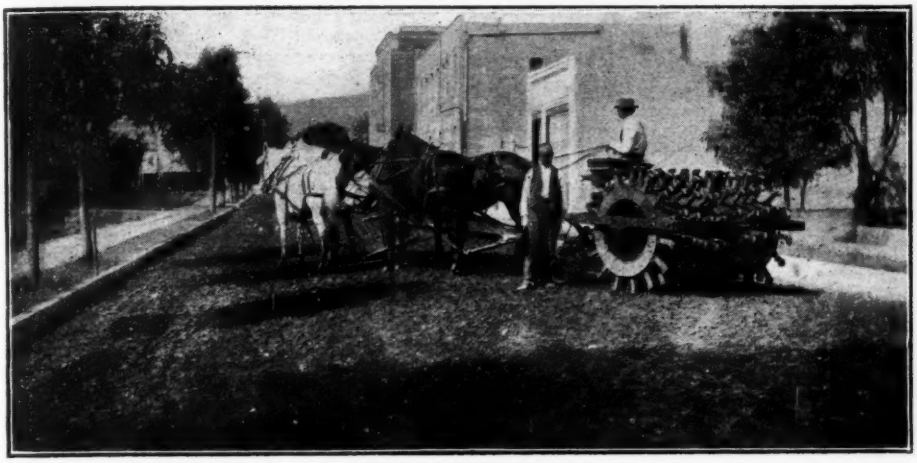
The use of oil on roads in California goes back perhaps about 30 years, but it was first merely splashed on the roads irregularly and indiscriminately. Real construction dates back only 8 to 12 years. Perhaps the real beginning of constructive work may be set at about 12 years ago, when a road builder in Kern County invented a sheep's foot tamping roller, now known as the petrolithic rolling tamper, and began to compact roads with it.

There are in southern California (the particular home of "oiled" roads) 1,500 or more miles of liquid asphaltic roads that may be considered as passably well built. There are hundreds more miles of oil-splashed roads, which are an improvement over the original dirt and sand roads, but can not be considered as modern liquid asphaitic constructed roads. These roads have been a very great element in the unparallelled development of southern California. Some of them are very cheap construction and are not to be compared with costly pavements; but in spite of cheapness they have served their purpose more effectively at less cost than any other county road system in any other part of America has served its community. No matter how wet the weather one can go practically all over the settled parts of southern California without getting into bad mud. No matter how dry, one can go almost everywhere without getting into bad sand or dust. Because of these roads our teamsters regularly haul two, four, six, eight and ten tons at a load—loads which ordinary eastern teamsters would consider as horrible nightmares. Because of these roads our people go about freely and easily thruout the entire section. Because of these roads, together with our equable climate, automobiles are in universal practical use. Automobiles have become invaluable in modern life, as incalculably increasing the range and amount of a man's capacity and activity.

The cheapest of these roads, which may be considered passably well built, have cost less than $1,000 per mile. The upkeep of these cheaper roads has varied under different circumstances between $25 and $50 per mile per year. As population and traffic have increased (and they have increased in many cases with overwhelming rapidity) the cheaper roads have been or are being replaced with more costly construction to meet the increased demands. The great increase of traffic which must be provided for may be gaged in some degree from the fact that many of our outlying country roads carry more and heavier traffic than the ordinary streets of many cities of the east having a population of 20,000 to 30,000.

Several streets still exist in South Pasadena which were petrolithic built nine or ten years ago of merely the native soil and oil at a cost of about 18c per square yard. These streets have had no repairs and though not in A1 condition, are yet so good that the city does not consider that they have to be repaired and the residents think the same.

Glendale, Los Angeles County, has a number of miles of liquid asphaltic streets, petrolithic built, using only the native sandy soil as it lay in the roadway. Most of the streets have been in use four, five and six years, have had no repairs, and are today equal in appearance to many of the sheet asphalt streets in some of the eastern cities, though not so hard. The Glendale streets cost from 18 to 35 cents per square yard.



CONSTRUCTING *an asphalt macadam street at Whittier, Cal. A petrolithic tamping roller is in the foreground.*

The country town of Lemoore, in Kings County, California, has several miles of liquid asphaltic streets, petrolithic built, with only the native sandy soil, at a cost from 14 to 18 cents per square yard. These streets lasted seven years before it was thought necessary to make any repairs on them.

After four to six years of use, pavements costing 25 to 30 cents per square yard are in excellent condition.

Monrovia, in Los Angeles County, has over 25 miles of asphaltic streets, most of which have been in service from four to six years. These streets are petrolithic built, using just the native soil, which, however, is an excellent granite gravel lying on the mountain slope. No expenditure for upkeep has been put on many of these streets, altho they are subjected to comparatively heavy trucking and auto traffic. On the few streets that have been retouched as yet the expenditure has been so slight that the street department has considered it negligible. The cost of construction has ranged between 25 and 30 cents per square yard. These streets are so good that visitors usually think that the pavement is costly sheet asphalt.

Ventura, California, has over 13 miles of liquid asphaltic streets, which were built about four years ago at a cost of about 58 cents per square yard. These pavements are a form of petrolithic built liquid asphaltic macadam. Some of them show some minor defects of construction, but as a whole they are considered by many of the residents as equal to sheet asphalt. Certainly no other equal aggregation of streets that cost less than $1 per square yard will stand comparison with them. There are no records of upkeep expenditure of any sort on them as yet.

Santa Ana, California, has several miles of liquid asphaltic streets which have been in service about three years. They are petrolithic built, asphaltic macadam, and cost between 59 and 68 cents per square yard. These pavements are on several higher class residence streets and side business streets, and are deemed by most of the residents superior to regular sheet asphalt. No repairs have yet occurred on the streets.

About 6½ miles of road lying along the foot of the mountains back of Pasadena, and constituting a link of the Los Angeles County good road system, was petrolithic built about two years ago, using only the soil of the mountain slope, which bears a large proportion of granite gravel. This road carries a great deal of automobile and hauling traffic and is subject to the wash of heavy mountain rains, yet it is proving superior to the great mass of much more costly 8-inch asphalt macadam laid about the same time. It is deemed one of the best pieces of road in the system.

North Grand ave., in Pasadena, has been under service for six years without any outlay for repairs. It is petrolithic built, liquid asphaltic macadam, and is in excellent condition today.

Pasadena has many miles of asphaltic streets of various grades and variously built. Its asphaltic macadams range between 1 inch and 6 inches in thickness of the actual stone pavement. Some of these streets carry a traffic of 1,000 to 1,500 automobiles a day, besides other light and trucking traffic. Some of the streets have records of very heavy haul-

ing. The asphaltic macadam pavements cost from $1 per square yard downward. Most of them have called for no repairs as yet. The extreme cost of repair, when misconstruction made necessary a partial reconstruction of the pavement, has been 4.5 cents per square yard or less; this cost covered scarifying and reshaping the entire surface, and pavements so treated are now A1.

The proper use of the petrolithic tamping roller is essential to the ultimate success of this type of pavement.

The petrolithic tamping roller is an implement to accomplish better compaction with greater ease and surety. But this increased efficiency of compaction can be accomplished only by using the implement in the proper ways. It has been so used many times as to gain nothing but trouble, expense and delay in the work.

The tamping roller is not a pressure roller in the same sense as the ordinary smooth roller. The ordinary smooth roller compacts by direct pressure of great weight, the tamping roller compacts by the thrust and pound of a small shoe with a small face. The smooth roller depends on the material giving evenly under it to irregular depths and the particles slipping over each other so readily as to fill all voids tight and to perfect compaction. This action, however, rarely takes place perfectly, for some parts tend to compress more quickly than others and then to carry the roller over the less compacted parts lying between. Hence the resulting compaction is usually uneven, spotted or streaked, and not positively reliable.

The tamping roller aims to compact a distinctly defined layer of material with approximately perfect uniformity. The layer of material is first loosened, evenly mixed and usually puddled to insure uniformity. It is then pounded, or tamped, by repeated going back and forth with the tamping roller until solid enough for the purpose in view. There can be no streaks or spots if the work is properly done.

The tamping roller will not efficiently compact a narrow, soft streak that lies between two hard streaks, or in equivalent position. It will not compact a small soft spot that lies in the midst of hard material. Such conditions indicate that the materials and process are not being properly handled. Since the tamping roller is composed of two rolling drums, each three feet in length and both mounted on the same axle, it inevitably follows that, if the soft place is too small for the roller to sink into across its entire length, the roller must necessarily bridge across to some extent and fail of perfect compacting. Even in such cases, however, it will often assist in discovering where such soft spots exist, though they may have been passed as perfect by a smooth roller. But proper effective tamping, to repeat, is accomplished by loosening the entire material to such a depth as is needed, evenly mixing it and then tamping it all down evenly in a uniform compaction. It differs from ordinary pressure compaction also in that it compacts from the bottom upwards instead of from the top downwards.

This compaction is of value in any work with earth, sand, gravel and similar materials, where there is need of increased density or increased carrying power. It is of especially great value in settling fills, in dam construction, including compaction of reservoir bottoms, and in roadway foundations. A signal instance of such compaction on a larger scale than common is that of the 52,500,000-gallon earth reservoir for oil, constructed in 1911 near San Luis Obispo, Cal., by the Union Oil Company of California. The material used contained 40 to 60 per cent. clay, any falling under that proportion being rejected. Sixty-four thousand cubic yards gross was compacted into 49,000 cubic yards in place, including some waste in handling and trimming. The supervising engineers estimate that the compaction was over 22 per cent. A cross section of the embankment, cut through to lay a pipe connection, showed no stratification; the entire embankment pared down from top to bottom like an extremely hard pressed cheese.

In applying the tamping roller to roadway construction there are certain definite principles to be kept in mind. Compaction by tamping primarily increases the carrying power of earth, sand, gravel and similar combinations. Secondarily, because of the increased density and carrying power, the wearing quality is increased, but not in equal proportion to the increase of carrying power.

A roadway of earth, sand, gravel or similar materials, when properly compacted with the tamping roller, is tremendously improved, but it still has the essential qualities of a roadway composed of such materials. The increased compaction does not make it over into the class of hard-metalled roads, as some extreme enthusiasts have seemed to assume and expect. If good road asphalt is properly worked into the surface of such roadways, the wearing quality is even more greatly increased, almost unbelievably increased in the case of particularly suitable materials; but the roadway, nevertheless, still lacks some of the wearing quality of a hard-metalled roadway. However, an important exception must be made to these

statements regarding gravel, in that if the gravel carries a large percentage of stone of good quality, the resulting roadway becomes distinctly an approximation toward a hard-metalled roadway, with similar wearing qualities. If this latter grade of gravel is properly combined with good asphalt, the result is an approximation towards an asphalt-concrete, with similar wearing qualities.

The term "petrolithic" is not meant to designate any particular pavement or type of pavement, but to designate methods of construction applicable to almost every type of roadway and pavement. There are earth, sand and gravel roadways in which the tamping was carried clear to the top, sometimes with and sometimes without using any asphalt. There are gravel roadways in which only the base was tamped, and then a wearing pavement of gravel smooth-rolled over it; in such construction asphalt is usually used in the gravel paving, though not nearly always in the base. In asphalt macadams tamping has been used to various extents; we recommend its use with macadams chiefly in the base. Tamping is used to compact earth and gravel bases for asphalt concretes, for cement concretes, etc. In every case, however, it should be remembered that the tamping roller is not a road-finishing (surfacing) implement, but a compacting implement.

WEST ADAMS STREET, *Los Angeles, Cal., pavement under construction. The city owns the outfit shown, which consists of a fifteen-ton Monarch roller, a petrolithic gang rooter, and a Hatch disc harrow.*

We regard a highway as composed of two great essential parts, which involve in themselves all other elements. The first is a carrying base or foundation; the second is a wearing surface or pavement. These may be combined in many ways, but a roadway must be planned from the standpoint of these two phases and must stand analysis according to them. In general paving of the more rigid heavy traffic type, such as concretes, blocks, etc., the tamping roller comes into service in compacting and uniformly developing the carrying power of the base. Maximum compaction and carrying power in the base enable the use of minimum thickness in wearing pavement above and at the same time insure more satisfactory and more enduring qualities in the roadway. The modifying relationship of these two parts of a roadway's make-up with each other and with reference to the result desired should be kept clearly in mind in planning or judging a roadway, if one is to plan or judge practically and effectually. Often materials that are cheap under local conditions may be so handled as to have compaartively (compared with needs) unlimited carrying power. The immediate wearing surface, however, should be formed of as efficiently hard metal as is practicable, all things considered. The great work of the tamping roller is to increase the efficiency of the base, to enable the use of locally cheaper materials in the base, to decrease the amount of wearing surface paving needed or increase the efficiency of what is used, and thus to produce a more resilient satisfactory roadway.

Considering traffic as the absolute condition, one might make the absolute statement that only a hard metal paving would give efficient results. But in actual practice traffic is only one of a number of conditions to be considered. The practical road builder must balance up together many conditions and make modifications accordingly. A hard metal surface becomes in many cases merely the ideal toward which to strive as far as posssible. Among many variants at least two modifying considerations may be taken to enter into the designing of every roadway. The first is the amount of funds available for construction. The second is the comparative value of the different styles of roadway possible, reckoned thru a stated period of years, which period must be determined by the various local conditions. Such comparative valuing must consider among other things the original cost or investment, the maintenance cost thru the determined period of years, the condition, or rather value, of the road-

way at the end of the period, the service value to the taxpayers or investors of each style of roadway, which service-value should take careful estimate of the destructive wear of each style of roadway on the animals and vehicles which pass over it—an item often entirely overlooked, which, nevertheless, has to be paid by the users of the roadway. These values should be carefully estimated from real practice and not from mere abstract engineering theory.

A careful study of traffic conditions necessary in order that a community can be sure of the most economical, permanent road.

The result of such comparison may determine that merely a good dirt road is the most economical for a given community, or a sand-clay road, or a gravel road, etc. As an instance in illustration the writer has several times, after summing up all the elements of the situation, had occasion to recommend a thoro compaction of the natural earth base by tamping and addition of one-half to one inch of hard gravel or crushed stone, with asphalt, for a wearing surface, in the case of light traveled country roads or small town residence streets, because, under the conditions pertaining, such construction involved exceedingly low first cost and exceedingly low maintenance cost and at the same time gave an exceedingly satisfactory and easy-running roadway for the traffic concerned.

Whatever the type of roadway or paving, petrolithic methods in connection with it stand for greater compaction, for greater uniformity of compaction, for greater and more dependable carrying power, for enabling the use of cheaper local materials underneath, for greater resiliency and consequently for greater economy in construction and maintenance and greater satisfaction in traveling quality. But the methods are not in themselves cheap methods, tho they may result in much lower cost of roadways. Compaction by tamping roller is usually somewhat more costly than by ordinary methods. Economy comes from the increased durability and satisfaction of the resulting roadway and from decreasing the expenditure and work necessary in certain other costly parts of the construction. In many constructions this economy shows strongly in the first cost; in other constructions it becomes evident only in the "period" cost.

The petrolithic gang rooter.

The petrolithic gang rooter, or rooter-scarifier, is a combination of plow, rooter and scarifier. It is built powerful enough to withstand the draft of the most powerful traction engine. It is greatly used by cities in connection with their road rollers for repair work on the dirt, sand, gravel and macadam streets. It will tear up anything that any traction can pull it through.

It does not depend on weight to force it into the ground, but has an essential tendency to dig, and must be held by the adjustment of the wheels from going deeper than is desired. Its operating width is five feet; it will tear up this width more easily than a moldboard plow will tear up one-fourth of that width. The five points, of specially tempered steel, are set at such an angle that they lift the loosened material with a shoveling action, sliding it into curved standards above to be finely broken; they are arranged in wedge formation so as to minimize draft and produce balanced action. The frame carries on three points—two rear wheels and one front truck; each of the three points adjusts separately, giving range of adjustment and ease of operation.

The gang rooter breaks the ground or roadway more easily and more finely than any other implement. It holds exactly to place, missing nothing. Street superintendents, road men and contractors find it invaluable in street work, road work and grading because it breaks to just the depth set, neither shallower nor deeper; it breaks to a regular level independent of ordinary ruts or depressions; it cuts thru everything in its way instead of being thrown out of course by obstacles and missing places; it stands the strain even if the obstacle is sufficient to stop the engine dead. In brief, the gang rooter is balanced in action, easy of draft, easy of operation, rapid in work, positive and uniform in cutting depth, unlimited in breaking-up power, durable under all conditions, more effective in work, more varied in its range of work.

It is used in all sorts of difficult street work, in difficult road work, in difficult grading and in difficult excavating. It is also being used agriculturally for difficult conditions. It is used where the ground is too hard for anything else. It is used to drag large boulders out of stony soils. It is used to tear large roots out of newly cleared land. It can be adjusted so as to have clearance equal to almost any usage.

The petrolithic rotary, or spike disc scarifier, operates on the same principle as a disc harrow, having, however, such weight and strength as is never thought of in a disc harrow. Instead of cutting discs, it has heavy cast discs in which are set powerful cutting spikes made of specially tempered steel and peculiarly curved. The implement is drawn back and forth over the surface to be scarified

or the clods to be pulverized until the required work is accomplished; the draft is from four to six horses. As the discs revolve the spikes are driven into the street or ground or clods by the force of impact and the weight of the implement; they cannot then be drawn out direct, but must tear their way out, ripping several inches in their passage. One of its many uses is to pulverize clods, particularly if they are too difficult for other implements or extra rapid work is needed. Another use is to scarify the surface of dirt, sand, gravel and macadam roadways without disturbing the solid base beneath. It is especially valuable on asphaltic streets where the asphalt tends to loosen in cakes and entirely clog the ordinary type of scarifier; in such cases it has enabled a light repair as required at a very low cost.

Street Paving in Toledo, Ohio

The city of Toledo, Ohio, has a peculiar foundation, much of the city being located on ground reclaimed naturally from Lake Erie in very ancient days and this being rather low and flat, tho its location near the lake is such that floods in its rivers can not disturb its equilibrium. The soil does not form a very satisfactory foundation for pavements, and difficulties with which other cities contend occasionally must be met here in a large part of the work.

The department of public works is able to cope with its problems and a trip over the streets under its charge shows conditions fully equal to the average of cities if not a little better.

The city engineer, George W. Tonson, has been connected with the department as commissioner or city engineer almost continuously for many years and the excellence of the work in the city is undoubtedly due in large part to his careful and conscientious attention to his duties.

Mr. Tonson is a member of the American Society of Municipal Improvements and a member and committeeman of the Society for Standardizing Paving Specifications, and he is using in large part the specifications adopted by the latter organization, which differ but little from those adopted by the former.

Some features of the Toledo paving specifications.

The latest edition of the Toledo specifications for street improvement provides for light gravity oil (1.03 to 1.08) and 16 pounds to the cubic foot of yellow pine, but several streets have been laid with blocks treated with heavier oil. The specification for asphalt is somewhat more open than the latest form of the standard specifications and several kinds of asphalt have been used with good pavements of almost every kind. Brick pavements have been laid with sand, asphaltic and cement fillers and the results seem to depend more upon the character of the foundation than upon the method of laying the wearing surface.

Wakeman street on a broken stone foundation with brick wearing surface and sand filler for joints was laid about twelve years ago and is in good condition, but there are many others of similar specification and less age which are in poor condition. Smith street, in front of the city stable, is of brick on concrete foundation with sand filler. It is five years old, in good condition and has had no repairs.

In asphaltic and bituminous pavements, similar results may be reported. Collingwood avenue was recently resurfaced after twenty-four years of wear at a cost of $1.20 a square yard. Madison street, fourteen years old, is in good condition. A number of old stone pavements have been improved by covering them with asphalt, usually with a binder coat about 1.5 inches thick and a surface coat 2 inches thick. The city has been very successful in this line on such streets as Euclid avenue, where the old Medina stone pavement was covered at a cost of $1.12 a square yard; Huron, from Adams to Jefferson, covered six years ago with California asphalt; Erie street in several sections, two to four years old, covered with asphaltic concrete, about 3.5 inches thick, using Trinidad asphalt.

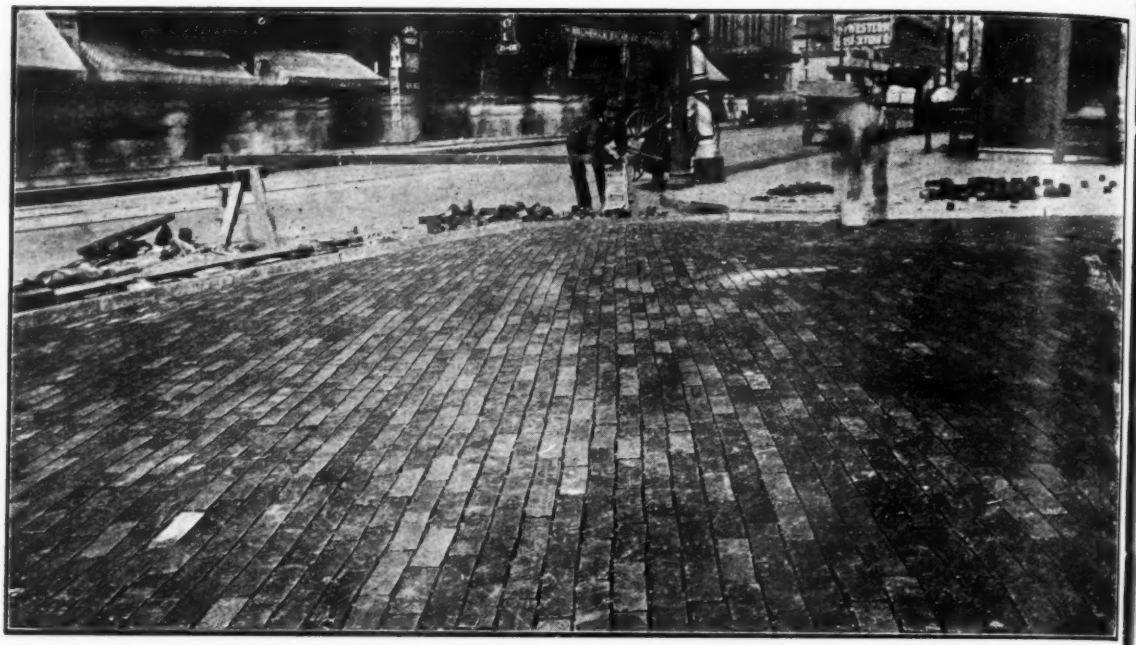
A new asphalt pavement on Main street, on the east side, laid in 1912, where traffic is heavy and concentrated by the street railway tracks, promises specially good wear, attributed by Mr. Tonson to the use of 11 per cent of bitumen in the top mixture.

The city is operating a new municipal asphalt plant, one of whose products in 1912 was West Woodruff street, which cost 98 cents a square yard for a thickness of 1.5 to 2 inches.

East Woodruff street has a bitulithic pavement laid in 1906 with broken stone foundation, which is in excellent condition.

But little stone is now used, a section of Lafayette street, laid with granite in 1912, being the latest.

Some asphalt block pavements were laid ten years ago or so. One in Parkwood avenue, laid in 1903, is in bad condition, especially when compared with another section of Parkwood avenue, laid in 1900 with creosoted yellow pine, 12 pounds of oil to the cubic foot, which has had no repairs during its life and is now in good condition.



JACKSON AVENUE, *Toledo, O., creosoted yellow pine wood lug block pavement under construction. Grade over 3 per cent.*

Toledo has about 10 miles, 200,000 square yards, of creosoted wood block pavement, Parkwood being the oldest. The next wooden block street laid was Monroe, 2.25 miles long, laid in 1904, using 16 pounds of oil per cubic foot of the yellow pine blocks. The wooden blocks are laid between the street car rails and there has been no repair required on this street during its nine years of life. In 1905 five streets were laid with 3-inch blocks, using 16 pounds of oil per cubic foot and three streets with 4-inch blocks, using 10 pounds of oil per cubic foot. In 1910 St. Clair street was laid with 3.5-inch blocks, using 16 pounds of oil, and Huron and Superior streets, old Medina stone pavements, were resurfaced with 3-inch yellow pine blocks, using 16 pounds of oil per cubic foot.

One block of Jackson avenue, from St. Clair to Summit, where the grade is over 3 per cent., was laid with yellow pine lug blocks. These lugs are cut two on one side and one on an end of each block and serve to separate the blocks instead of using a lath to separate them in the process of laying. The lug block pavement can be used on a street with heavy grade, even heavier than that of Jackson avenue without danger of horses slipping. A team was observed hauling 50 cubic feet of sand up the Jackson street grade without hesitation or fear of slipping. The joints of this pavement were filled with sand, but a compressible pitch filler can be used. The blocks used on this street were treated with 16 pounds of oil of 1.08 to 1.10 gravity and have bled to some extent. A light dressing of slag sand is applied at intervals to all wooden block pavements. The dressing lasts about a year and seems to be beneficial to the durability of the street as well as to help take care of the bleeding of the blocks. The lugs are compressed when blocks swell and thus take care of the expansion from absorption of moisture. All wood blocks in Toledo are laid on a mortar bed without sand cushion.

An old stone pavement on Huron street was covered with about an inch of cement mortar and wooden blocks were laid on this bed before it had set.

The only concrete pavement observed was under the sheds of the new wholesale-market house where it is protected from the weather. This pavement was laid in the fall of 1911 and is in excellent condition with but few cracks.

The activity of the city in paving matters is shown by the fact that 53 contracts for street paving are under construction.

Macadam Road Construction Statistics.

By John McNeal, M. Am. Soc. C. E., City Engineer, Columbia, S. C.

A MONOPOLISTIC corporation has been termed one whose operations are not subject to the effect of competition. Municipalities may in a measure be classed under this head, but while actual competition is wanting in the business operations of a city, many opportunities are presented for comparative cost accounting, which should have a tendency to create competition and materially reduce the cost of municipal work.

Physical statistics and cost accounts properly utilized reveal leaks in the management of municipal departments, which the wide awake official will endeavor to correct.

The following tabulated statements show the cost of macadam work done under the supervision of the writer in Easton, Pa., during the years 1906 to 1909 inclusive. These statements show the cost of the work in detail as well as the calculated depth of the finished road. In calculating the depths, it was assumed that a cubic yard of loose stone weighed 2,400 pounds and that 1 6/10 cubic yards of loose stone compacted to one cubic yard. In some cases the depth of finished road slightly exceeded this calculated depth due to the variation in weight of the material.

The increases in rates of labor, etc., during the year 1907 and the years following, show a proportional increase in the cost of the work.

Considerable variation is shown in the cost per square yard for sprinkling and spreading crushed stone. The former is due largely to weather conditions and the latter to the delivery of the stone on the street, delays in delivery increasing the cost.

The change in price of crushed stone from year to year as shown on the attached statement, also altered the cost per square yard of the crushed stone item.

COST PER SQUARE YARD OF MACADAM WORK IN THE CITY OF EASTON, PA., FOR THE YEAR 1906.

Street	Width, ft.	Length, ft.	Area, sq. yds.	Calculated depth	Cost in Cents per square yard. Grading	Crushed Limestone	Spreading Stone	Crushed trap rock	Sprinkling	Rolling	Drain pipe	Total cost
Taylor Ave, first section....	700	20	1555	4 3/4	..	21.8	3.2	...	1.2	1.3	4.4	31.9
Taylor Ave., second section..	825	20	1833	4 1/2	9.6	21.0	2.6	...	0.3	2.0	..	35.5
Delaware River Road.....	2100	12	2800	5 1/4	..	23.0	1.8	...	1.2	1.4	..	27.4
Burke	1272	30	4240	4 3/4	3.9	22.0	1.9	...	0.6	1.5	0.8	30.7
Brodhead	334	30	1113	6 1/4	0.8	28.8	2.9	...	0.5	1.5	..	34.5
Sitgreaves (Terry-Lehigh)..	470	9	470	6 1/4	..	10.8	1.6	30.5	0.7	2.6	2.8	49.0
Second	230	30	767	4 1/4	8.0	18.8	2.5	...	0.7	1.6	..	31.6
Green	480	9	480	3 1/2	..	14.3	4.9	...	1.3	1.7	..	22.2
Terry	480	27	1440	4 3/4	..	1.8	2.8	34.0	1.0	2.1	..	41.7
Bushkill (Fourth to Pearl)..	400	13	577	6 1/4	..	28.2	6.7	...	4.0	2.1	..	41.0
Wood (Seventh-Eighth)	440	18	880	4 1/4	1.7	18.8	1.7	...	0.3	..	..	22.5
Dock	1700	10	1888	3	..	9.5	1.6	6.8	0.8	1.4	..	20.1
Fourteenth	450	30	1500	4 1/2	1.5	19.9	2.4	...	0.3	1.1	2.2	27.4
Bushkill (12th-13th).....	470		990	5 3/4	3.9	26.0	1.4	...	0.2	2.5	1.2	35.0
Spruce (12th-13th)	470	10	522	3 1/4	..	14.4	1.7	...	..	0.8	..	16.9
Valley Ave.	300	24	800	5	..	22.6	2.0	...	1.2	1.5	3.8	31.1
Milton Ave.	770	24	2053	5	5.2	22.9	2.2	...	1.0	2.0	1.4	34.7
Average												31.4

COST PER SQUARE YARD OF MACADAM WORK IN THE CITY OF EASTON, PA., FOR THE YEAR 1907.

Cost in Cents per square yard.

Street	Length, ft.	Width, ft.	Area, sq. yds.	Calculated depth, in.	Grading	Crushed limestone	Spreading stone	Crushed trap rock	Sprinkling	Rolling	Drain pipe	Hauling and Breaking	Total cost
Bushkill (2nd-3rd)	500	30	1667	6	3.2	23.8	2.9	9.4	1.0	3.7	..	...	44.0
High	300	30	1000	8 1/2	1.5	40.6	2.9	..	1.4	3.3	..	...	49.7
Parker Ave.	1300	14.75	2130	6 1/2	6.7	32.1	4.2	..	1.2	2.9	4.4	...	51.5
McCartney (Monroe-Pierce)	320	30	1067	9	4.2	43.7	2.9	..	1.3	2.7	..	...	54.8
Union	380	11	464	3 3/4	...	18.2	3.1	..	0.8	2.3	..	...	24.4
Bushkill (8th-10th)	715	22	1748	4 3/4	3.5	23.2	2.5	..	1.3	2.0	..	...	32.5
Bus'ill (W'd-12th)	250	30	833	4 1/4	10.8	20.9	2.4	..	1.0	1.6	..	...	36.7
Washington (7th-Walnut)	600	31	2043	4 1/4	...	20.0	2.0	..	1.0	2.0	..	...	25.0
Lincoln (C'l-Centre)	765	24	2040	4 1.4	1.2	20.7	1.9	..	0.5	1.9	..	8.1	34.3
Wilkes-Barre	520	24	1387	4 1/2	8.5	22.2	2.4	..	0.8	1.3	..	...	35.2
St. John	722	18	1444	3 3/4	7.9	16.4	1.9	2.2	1.3	1.0	..	...	30.7
Kleinhans Ave.	500	18	1000	3 1/2	...	17.1	2.0	..	0.9	3.1	2.2	17.4	42.7
Berwick (Cen.-Val.)	1220	14.5	2899	7	11.0	33.5	3.7	..	0.9	4.4	..	...	53.5
(Davis-Coal)	360	24	960	3	1.7	14.0	1.3	..	0.5	1.4	..	...	17.9
Berwick	360	24	960	3	1.7	14.0	1.3	..	0.5	1.4	..	...	17.9
Lincoln	360	24	960	5 3/4	...	27.6	3.2	..	0.5	2.3	..	...	33.6
Northampton St. (6th-7th)	990	27	2970	4 1/4	...	16.5	2.2	4.8	0.9	1.2	..	...	25.6
Average	...	..	....	....	...	...	..	..	..	..	..	...	37.0

COST PER SQUARE YARD OF MACADAM WORK IN THE CITY OF EASTON, PA., FOR THE YEAR 1908.

Cost in Cents per square yard.

Street	Calculated Depth, in.	Length, ft.	Width, ft.	Area, sq. yds.	Grading	Crushed Limestone	Trap Rock Screenings	Spreading Stone	Hauling and Breaking	Sprinkling	Rolling	Drain Pipe	Total Cost
Northampton	4)	978	30										
(7th-11th)	4)	726	15	4470	1.2	22.3	...	1.4	..	1.1	1.5	..	27.5
Cattell	5	758	25	2106	1.6	27.4	...	2.2	..	2.3	3.3	..	36.8
Paxinosa Ave.	4 1/4	400	25	....	...	...	...	...	..	..	..	..	...
		410	12.5	1680	1.3	23.6	...	1.4	..	1.0	1.8	..	29.1
McCartney (Pierce-Burke)	6 1.2	308	30	1027	12.5	36.6	...	3.3	..	2.8	3.8	..	59.0
McCartney (Parsons-Monroe)	6	333	30	1110	7.1	33.9	...	2.8	..	1.6	2.4	..	47.8
Mulberry	4 3/4	237	10	263	...	26.7	...	3.1	..	1.1	1.8	..	32.7
Monroe	4	270	30	900	0.4	22.3	...	2.6	..	1.1	2.2	..	28.6
Butler (10th-11th)	3 1/4	961	22	2349	1.3	15.4	1.5	1.6	..	1.3	2.4	..	23.5
Wood (11th-Bushkill)	5 1/4	300	30	1000	...	28.8	...	3.3	5.0	1.6	2.6	3.9	45.2
Wood (8th-9th)	4 1/2	450	30	1500	1.7	25.4	...	2.3	7.5	0.8	2.1	..	39.8
Old Phila. Rd.	3 3/4	730	24	1947	...	21.4	...	1.8	4.8	1.3	1.9	..	31.2
St. Joseph	4 3/4	300	24	800	4.0	27.1	...	1.8	7.3	0.6	2.4	..	43.2
Berwick	3	402	24	1072	...	17.1	...	1.6	..	1.3	1.9	..	21.9
Nesquehoning	4	500	24	1333	...	23.6	...	2.3	4.0	1.2	2.5	..	33.6
Davis	5 1/4	731	7.5	689	9.6	30.0	...	2.8	..	2.2	4.0	..	48.6
Lincoln	3 3/4	867	24	2312	3.6	21.7	...	1.8	5.9	1.0	2.5	1.3	37.8
E. Canal	3 1/4	640	15	1067	0.6	6.4	19.2	2.5	..	2.1	2.5	..	33.3
Lehighton	5 3/4	3400	12	4533	2.5	32.0	...	2.8	..	2.0	2.8	1.0	43.1
Average					3.7	24.5	10.4	2.3	5.8	1.5	2.5	2.1	36.8

COST PER SQUARE YARD OF MACADAM WORK IN THE CITY OF EASTON, PA., FOR THE YEAR 1909.

Cost in Cents per square yard.

Street	Length, ft.	Width, ft.	Area, sq. yds.	Calculated Depth, in.	Crushed Limestone	Grading	Spreading Stone	Hauling and Breaking	Sprinkling	Rolling	Weighing Stone	Total Cost
Ferry (7th-8th)	438	30	1460	3.5	17.6	1.1	1.7	..	0.7	2.9	0.7	24.7
13th (Washington-Butler)	264	30	880	4.5	24.4	2.3	3.5	..	0.7	2.9	0.8	34.6
McCartney (Lafayette-Knox)	334	30	1113	6.5	35.4	3.0	3.1	..	1.4	3.6	1.2	47.7
Berwick (Seitz av. east)	384	9.5	405	6.0	32.4	15.2	2.8	..	1.5	4.6	1.4	57.9
Berwick (Reynolds-Centre)	360	24	960	3.0	16.0	2.0	1.8	..	1.4	2.7	0.7	24.6
St. Joseph (Charles-Phil. rd.)	360	24	960	4.0	20.4	0.8	2.6	..	1.7	1.9	0.9	28.3
Nequehoning (St. John-Davis)	650	24	1733	4.0	22.1	1.9	1.7	..	1.6	2.7	0.8	30.8
Valley Ave. (Bird-Milton)	160	24	427	3.5	18.1	4.3	1.2	..	2.6	3.8	0.6	30.6
High (McCartney-Sullivan)	388	30	1293	5.5	30.7	5.9	2.3	8.7	1.7	3.4	1.4	54.1
Reeder (Pierce-Monroe)	344	30	1147	3.25	17.1	4.0	1.9	8.2	0.6	3.0	..	34.8
Pine (11th-Peach)	1167	9	1167	4.0	21.8	..	2.1	4.6	1.4	2.4	0.7	33.0
Pearl (7th-8th)	331	16	588	4.75	25.4	..	2.4	6.1	1.8	5.5	0.8	42.0
Warren (Northampton-Sp. Garden)	662	16	1177	4.0	21.5	2.9	2.3	..	0.9	1.8	0.5	29.9
Lincoln (Parker east)	350	24	933	4.75	25.7	11.2	2.0	1.9	0.5	2.7	0.7	44.7
Ann	412	24	1098	2.75	14.8	..	1.2	..	1.1	2.9	..	20.0
Average												35.6

COST PER SQUARE YARD OF REPAIRS TO MACADAM WORK IN THE CITY OF EASTON, PA.

Cost in Cents per Square Yard.

Street.	Length, ft.	Width, ft.	Area, sq. yds.	Calculated depth.	Grading	Crushed Limestone	Spreading stone.	Crushed trap rock.	Sprinkling.	Rolling.	Drain pipe.	Weighing stone.	Total cost.
For the Year 1906—													
Chestnut	1200	20	2667	2 1/2	..	..	1.8	19.4	0.8	2.5	..	..	24.5
Front	800	25	2222	1 1/2	3.0	3.5	1.3	5.1	0.3	1.5	..	..	14.7
Fourth	770	25	2139	2 1/4	..	6.6	1.1	5.3	0.9	1.3	..	..	15.2
Bushkill	480	30	1600	1	2.8	..	..	7.4	..	1.3	..	..	11.5
Sitgreaves	950	9	950	2	..	..	0.7	15.1	0.4	1.3	1.4	..	18.9
Wood (12th-13th)	450	30	1500	2 3/4	..	12.9	1.2	..	0.5	1.3	..	..	15.9
E. Canal	1400	12	1867	2 1/2	..	19.9	1.8	..	0.4	1.1	..	..	23.2
Line	745	12	993	2 1/4	3.7	10.5	2.6	..	0.6	1.7	..	..	19.1
Average													17.9
For the Year 1907—													
Old Phila. Road	1400	15	2334	2 1/4	2.5	10.9	1.1	..	0.8	0.6	..	..	15.9
For the Year 1909—													
N. 3rd	760	44	3716	1 1/2	1.2	3.6	0.8	7.9	0.7	1.1	..	0.4	15.7
Front	480	30	1600	2 1/4	1.1	11.8	0.9	..	1.0	1.8	..	0.4	17.0
S. Del. R. Rd.	1383	16	2458	2 1/2	..	14.0	1.2	..	1.1	1.3	..	0.4	18.0
Average													16.9

PRICES PAID FOR MATERIAL AND LABOR ON MACADAM ROAD WORK, EASTON, PA., 1906-1909.

Year.	Crushed Limestone per 2000 lbs. del. on sts.	Crushed Trap rock per 2000 lbs. del on sts.	Foreman per hour.	Labor per hour.	Road Roller Engineer per hr.	Team per hour.	Carts per hour.
1906	$0.85	$1.50	20c	15c	25c	40c	25c
1907	0.90	1.58	30c	20c	30c	50c	30c
1908	1.05	1.65	30c	20c	30c	50c	30c
1909	1.02	1.58	30c	20c	30c	50c	30c

Creosoted Wood Block Pavements in Boston

By James H. Sullivan, Engineer Public Works Department, Boston, Mass.

The chief points for consideration in the paving question are to secure a pavement that is not affected by changes of the weather or variations in temperature; that is durable, reasonable in price from the standpoint of total cost; that is sanitary and easily cleaned; that gives least resistance to traction; that affords greatest security to traffic, in the elimination as far as possible of accidents caused by uneven, defective or slippery pavements. Opinion differs somewhat as to the relative importance of these considerations.

Several American cities have conducted some expensive experiments in paving problems and some of the most eminent authorities, both at home and abroad, have, after careful investigation and extended comparisons, expressed their firm conviction that, from all considerations, there is no pavement now laid that equals the creosoted wood block pavements. There are many reports of tests and investigations by competent engineers and experts showing the durability of creosoted wood blocks pavements to exceed that of any other paving material.

Boston was the pioneer in wood block paving in the eastern states, the first treated wood block pavement being laid in 1900 in Tremont street. Since then more or less of it has been laid each year. The greater part of the pavement is laid with long-leaf yellow pine, which gives the best and most durable pavement. A few streets were laid with treated black gum, but from a want of knowledge as to the method of treatment or seasoning the block this black gum is not wearing well, consequently we are confining our specifications to hard long-leaf yellow pine.

I consider a treated long-leaf yellow pine block suitable for any traffic. Blocks that have been under wear for thirteen years are apparently as serviceable as ever. Some of these blocks were taken up a few years ago as a matter of curiosity to determine how the traffic did affect them, and while we might say the block was possibly one-fourth inch less than the original four inches in depth, it is difficult to say whether that one-quarter inch was due to wear or to compression due to impact; this in a street where the vehicular traffic averages about 9,000 per day of ten hours. We are contracting this season for about 40,000 more square yards of long-leaf yellow pine wood block paving. The maintenance of our wood block paving has not cost the contractors or the city anything during the past twelve years, nor do we look for any outlay in the immediate future, judging from present conditions.

CREOSOTED *wood block pavement in Boston, Beacon Street, near Bay State Road.*

Following is list of streets paved with creosoted wood block, January 13, 1913, totaling 71,611 square yards, in the city of Boston proper, 19,698 square yards in Roxbury, 1,981 square yards in South Boston, 21,231 square yards in Dorchester, or 114,521 square yards in all:

WOOD BLOCK PAVEMENT IN BOSTON.

Street	Limits	Length in feet	Area sq. yds.	Year laid
	City Proper.			
Atlantic avenue	811 feet south of Kneeland street to 1,263 feet south of Kneeland street (bridge)	452	1,996	1906
Avery street	at Washington street (crosswalk)	12	8	1906
Avon street	at Washington street (crosswalk)	9	20	1906
Batterymarch street	at Milk street north and south sides (crosswalks)	14	42	1911
Beacon street	Massachusetts avenue to Raleigh street	1,527	8,145	1901
Boylston street	Boylston Place across Charles street	433	1,690	1901
Chandler street	Berkeley street to Castle square	504	2,216	1912
Charles street	at Boylston street	30	243	1901
Church street	at Boylston street (crosswalk)	13	45	1908
Church street	Fayette street to Melrose street	175	521	1911
Cortes street	at Ferdinand street (crosswalk)	8	20	1911
Eliot street	east side Pleasant street to Columbia avenue	163	800	1907
Fayette street	Pleasant street to Ferdinand street	856	1,948	1911
Ferdinand street	B. & A. railroad bridge to Isabella street	376	1,069	1911
Hammond street	Shawmut avenue to Tremont street	1,115	4,214	1912
Harvard bridge	Boston side of draw to 270 feet west of southerly abutment (plank base)	708	3,663	1912
Harvard bridge	270 feet west of southerly abutment to southerly abutment (plank base)	270	1,411	1912
Harvard street	Washington street to Harrison avenue	408	861	1910
Hayward Place	Washington street to 9 feet easterly (crosswalk)	9	20	1906
Isabella street	at Ferdinand street (crosswalk)	8	20	1911
Kilby street	at Milk street (crosswalk)	6	70	1910
Malcolm street	Pinckney to Mt. Vernon street	312	244	1912
Massachusetts avenue	Albany street to Harrison avenue (northerly roadway)	...	1,899	1912
Massachusetts avenue	Harrison avenue to Washington street (northerly roadway)	...	2,009	1912
Massachusetts avenue	Washington street to Shawmut avenue (norherly roadway)	...	1,003	1912
Massachusetts avenue	Shawmut avenue to Tremont street (northerly roadway)	...	2,889	1912
Melrose street	Pleasant street to Ferdinand street	743	1,901	1911
Milk street	Pleasant street across Oliver street	300	1,156	1910
Milk street	Oliver street to Broad street	279	1,045	1911
Newbury street	Fairfield street to 205 feet east of Hereford	750	3,000	1901
Northampton street	Tremont street to Shawmut avenue	894	3,370	1911
Oliver street	Milk street to 152 feet southerly	152	591	1910
Park square	Boylston street across Eliot street	482	4,100	1907
Pearl street	Milk street to 153 feet southerly	153	508	1910
Pleasant street	Eliot street to Park square	93	425	1907
Providence street	74 feet east of Church street to Park square	151	1,400	1912
Public alley No. 442	between Newbury street and Boylston street from Gloucester street to 110 feet east of Gloucester street	110	98	1901
State street	Washington street to Devonshire street	115	530	1908
Summer street	Washington street to Hawley street	234	990	1908
Tremont street	23 feet norh of Beacon street to 21 feet south of Beacon street	65	231	1900
Tremont street	18 feet north of Park street to southerly street line of Temple Place (on the westerly side)	...	1,064	1900
Washington street	Milk street to Beach street	2,279	8,660	1906
Washington street	Cornhill street to 78 feet south of Court ave.	509	1,475	1908
Washington street	south side of Milk street to 78 feet south of Court avenue	538	1,860	1907
Water street	Devonshire street to Congress street	213	956	1907
West street	Washington street to Tremont street	463	1,126	1908
Whitmore street	at Harvard street (crosswalk)	6	10	1910
	South Boston.			
Boston street	Ralston street to N. Y., N. H. & H. R. Ry. bridge	193	531	1911
E. Fourth street	P street to 97 feet west of Farragut road	426	1,450	1911
	Roxbury.			
Dudley street	Guild row across Harrison avenue	841	4,134	1912
Falmouth street	Norway street to Massachusetts avenue	634	2,433	1909
Guild row	42 feet north of Dudley street to Dudley street	42	257	1912
Harrison avenue	at Dudley street (crosswalk)	16	72	1912
Massachusetts avenue	bridge over B. & A. railroad	75	500	1908
Newbury street	205 feet east of Hereford street to Hereford st.	205	820	1901
Newbury street	easterly side of Hereford street to Mass. ave	705	2,820	1903
Norway street	Falmouth street to St. Paul street	307	917	1909
St. Paul street	Falmouth street to Norway street	299	777	1909
Warren street	at Washington street (crosswalk)	10	73	1911
Warren street	at Dudley street (crosswalk)	23	216	1912
Washington street	Williams st. to 27 feet north of Marvin st.	1,026	4,779	1911
Washington street	Zeigler street to Dudley street	186	745	1911
Washington street	130 feet south of Dudley street to Dudley st.	150	1,035	1912
Westminster street	at Hammond street (crosswalk)	23	120	1912
	Dorchester.			
Bowdoin street	east sde of Quincy street to 78 feet west of Mt. Ida road	386	1,885	1909
Washington street	Moultrie street to Center street	182	850	1907
Washington street	Blue Hill avenue across Bowdoin street	4,115	18,496	1912

Our experience with creosoted wood block paving has been most pleasing to all concerned. The fact that the pavement on Tremont street, which has been in service for twelve years, has cost absolutely nothing for repairs, influences our opinion that creosoted wood block pavements are economical in every sense of the word for both heavy and light traffic streets.

Our experience, however, is akin to other large municipalities. In the borough of Brooklyn, New York City, the first creosoted wood block pavement was laid in 1902, without any guarantee, and has cost absolutely nothing for repairs. Pavements that were laid later and have been out of guarantee from three to four years, have been kept in repair by the borough and an accurate record kept of their cost. Some of the streets have cost absolutely nothing, and the average cost for the entire area out of guarantee has been 1 1-20 cents per yard per year. Many of these pavements, however, have been opened for sub-surface work, and the engineer in charge of pavements states that, in his opinion, practically all of the repairs are due to settlements over trenches, and damage caused by fires, and not to actual wear and tear of traffic. The borough of Manhattan, New York City, has three streets which have been out of guarantee three years, one of heavy traffic, one of medium traffic and one of light traffic. The heavy traffic street has cost 7 cents per yard per year, while the average of all has been 8 cents per yard per year; but it should be explained here, as in the case of the Brooklyn streets, that the repairs have been due to wear and tear only on the heavy traffic street, which is a wholesale street in the business section. Repairs on the other streets are due to settlements over trenches, damage caused by fire, and practically nothing to wear and tear of traffic.

Narrow Concrete Pavement for Country Roads

Under the new state aid law in Minnesota, Winona county has built a number of miles of narrow concrete road with macadam wings, the success of which will be watched with much interest.

The road consists of a strip of concrete in the middle, 8 feet wide and 6 inches thick, with a crown of 1 inch. On each side is a strip of macadam, rolled, of 2½-inch stone, which is 6 inches deep at the concrete, 4 inches deep at 4 feet out and tapers to nothing at 6 feet out. The total width is therefore 20 feet of which about 16 feet is valuable for travel, the outer 2 feet on each side being only a crushed rock shoulder.

The weak spot in the road is the junction between the concrete and macadam. If the macadam is too high it causes the water to get under the concrete and cracks it and if the macadam is too low the wheels drop off the concrete and cause the macadam to ravel and form holes.

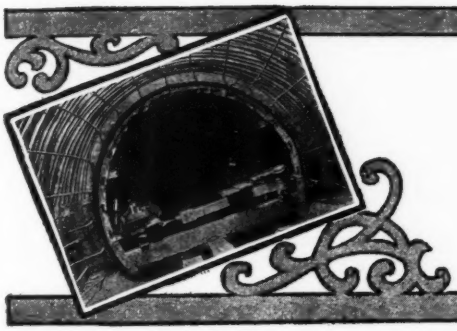
An observer of the Cuyahoga county, Ohio, roads would suggest putting the macadam all on one side so that there would be less turning off of the concrete and so that the horse traffic could keep to the macadam road when it desired, which seems to be most of the time. However the concrete road is not slippery, even on 7 per cent. grade, except on a few days of sleety weather.

The concrete costs about 90 cents a linear foot of the road, the macadam, 25 cents, and the grading including culverts about $1,500 a mile. Sixteen miles of road have cost $116,000. Hauling of wagon trains by tractor proved to be economical. Cement was hauled an average of 6 miles at about 20 a barrel. Gravel and sand cost about 20 cents a yard per mile for hauling, but under the most favorable conditions the cost was less than 6 cents a yard per mile.

Better Surfaces for Main Highways

The demand for better types of construction for the main highways thru the states is becoming stronger each year. New York state investigations show the necessity of durable surfaces such as brick or concrete. The state engineer of Illinois recommends brick or concrete for the state aid main roads. A concrete road is almost to the construction stage between Chattanooga and Knoxville, Tenn. It is demanded that as much as possible of the Lincoln highway be built of concrete. These facts show that the widespread demand from all sorts of country for the best road construction.

Some of the reasons for this are shown in the following comparisons of amounts of traffic: Thus France has one automobile to each 520 people and to nearly 5 miles of road. The United States has one for every 87 people and for a little more than 2 miles of road, while New York has an automobile for every 85 people and for every ¾ mile of road. The tendency of automobilists and automobile trucks toward increase of traffic on country roads is becoming more pronounced each year and the demand for adequate road surfaces must be met in other states than New York and Ohio and the few others which are attempting to meet that demand.



SANITATION

Cleaning Capital Streets

By J. W. Paxton, Supt. of Street Cleaning, Washington, D. C.

Previous to July 1, 1911, street cleaning in Washington, D. C., was done by contract under the direction of this division, but paid for from the appropriation for the maintenance of each building in proportion to the quantity removed.

Thruout the past year the following work was done under the immediate direction of this division:

Machine Cleaning—The cleaning of all paved streets outside the white-wing area every two days. On July 1, when this work was taken over from the contractor, the area cleaned amounted to about 2,500,000 square yards. During the year transfers were made in favor of white-wing work, reducing this area to about 2,167,000 square yards.

Alley Cleaning—The cleaning of all paved alleys in the District of Columbia about once every week. Additional alleys have been paved and added to those previously cleaned, bringing the total area cleaned from 985,000 square yards on July 1, 1911, to 1,033,000 square yards on July 1, 1912.

Suburban Cleaning—The cleaning of all macadam, gravel and unpaved streets not taken care of by the county, about once every ten days. During the past year additional territory was taken from the division of county roads and the total area increased from 905,000 square yards to 1,416,480 square yards.

Hand Patrol—The daily cleaning of all streets in the central portion of the city, amounting to about 2,005,000 square yards up to April 1, on which date this area was increased by 398,000 square yards and on May 1 still further added to, the present area being 2,745,804 square yards.

Flushing—The flushing of cobble stone, granite, asphalt block and poorly paved streets in the white-wing section of the city, amounting to about 300,000 square yards, washed about twice weekly.

Squeegeeing—The squeegeeing of nearly all of the smoothly paved streets in the white-wing area two or three times each week. Up to April 1 the area squeegeed amounted to about 1,368,000 square yards. Additional territory was added on this date, bringing the total up to about 1,766,000 square yards.

Dust Prevention—The sprinkling during the summer and fall of 1911 of about 60 to 70 miles of macadam gravel, and unpaved suburban streets. No sprinkling was done during the spring of 1912. The oiling during the spring of 1912 of practically all the suburban territory, the entire area being covered about six times.

Unit costs have steadily decreased thruout the year and the averages are considerably lower than the cost of the contract work prior to June 30, 1911. In addition to the greater economy, it is believed that the work has been of a higher quality and the streets and alleys have been kept cleaner. The success of municipal street cleaning is attributed largely to the fact that it is much more flexible than the contract system.

Under the old method of machine and alley cleaning every street and every portion of each street received the same amount of sweeping and the same price paid for each thousand square yards swept, whereas under the present system more effort can be put on the streets and on the portions of each street which have the most traffic and therefore tend to be more dirty. Under the contract system, the schedules were arranged for each day's work and that amount performed each day whether it required a full day's work or not. Under the present system continuous schedules have been arranged so that each foreman and his gang clean as much area as is possible in the eight hours constituting a day's work and commence again the next morning where they left off the night before.

Experiments during the previous year in street washing by squeegee and flushing machines proved so successful that

this method has been permanently adopted and the work will be extended as funds are available. The squeegee machines are operated in batteries of one sprinkler and three squeegees, the sprinkler operated some distance ahead to allow the dirt which has become baked and stuck to the pavement to be softened by the absorption of water and easily dislodged by the squeegees. With one battery, which works in the hilly section of the city, it has been found necessary to use three horses on each squeegee machine. Four additional squeegee machines have been purchased during the year, making a total of eight. Two flushing machines have been purchasing during the year, making a total of four. It has been the endeavor to cover nearly all the hand-patrol area two or three times a week with these washing machines, and in order to do this it has been necessary to work some of the machines on a double shift. By this system of street washing it is found that the streets are almost entirely free from dust. Any dirt which may accumulate does not have time to be pulverized and the particles are too heavy to be disturbed or blown about by an ordinary wind. Under the old method of cleaning these heavier and coarser particles were removed, but most of the dust remained to become a source of annoyance when disturbed by the wind or rapidly passing vehicles, altho the streets appeared to be clean.

amount on hand, and when and where issued, the index totaling about 1,600 cards. Another important feature of this card system is the establishment of maximum and minimum limits for each kind of stores, thus preventing any overstocking or shortages as stock is automatically purchased when the minimum limit is reached. Other advantages are the location of stock, all stock correctly priced, no stock lost, a check on supplies ordered, exact records of stock used and where used, and a perpetual inventory of stock always an hand and up to date.

No change has been made in the methods of keeping time for per diem employes, but the time book is now checked with the cost-keeping account, which eliminates possible errors.

Before being issued, the schedules of streets to be cleaned are platted on celluloid sheets mounted over maps and very carefully studied to prevent any dead travel. The areas of all streets cleaned have been accurately determined from the records of the surface division. Schedules are changed only upon order of the superintendent or assistant superintendent, and foreman allowed to clean only the streets on their respective schedules. Reports of the cleaned streets are sent into the office daily, and the areas computed.

The following records may prove of interest to readers of MUNICIPAL ENGINEERING:

	1911. Sq. Yds. Cleaned.	1911. Total Cost.	1911. Cost per 1,000 Sq. Yds.	1912. Sq. Yds. Cleaned.	1912. TOTAL COST.	1912. Cost per 1,000 Sq. Yds.
Hand patrol....	536,897,423	$94,134.48	$0.1753	646,377,000	$98,132.85	$0.152
Mach. sweep'g..	367,242,484	83,547.67	.2275	337,990,000	54,623.72	.162
Alley cleaning...	38,396,138	15,358.44	.40	54,664,000	17,752.45	.324
Suburban sts....	40,194,274	17,006.26	.....	27,825,000	14,559.76	.....
Squeegee	50,012,859	5,814.57	.1162	98,328,000	9,407.58	.096
Flushing	5,589,367	1,765.12	.3157	8,747,000	2,385.84	.272

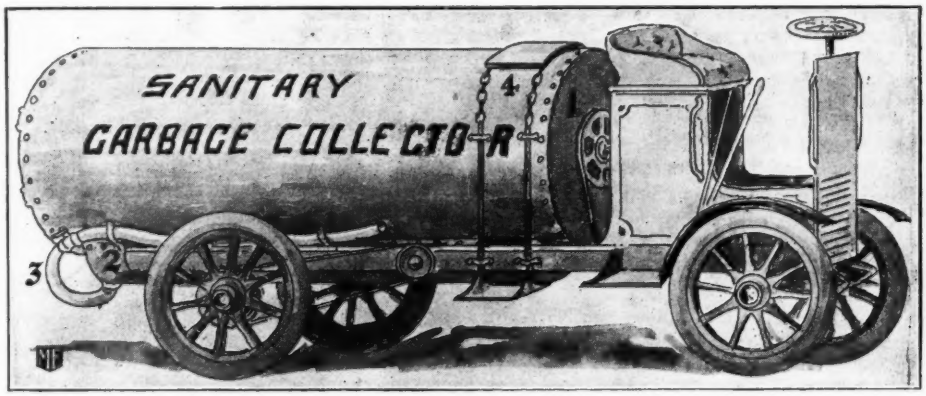
During the past year a cost-keeping system has been developed with the idea of attaining, thru the study of comparative costs, greater efficiency and economy. This necessitated among other things the establishment of a modern method of store-keeping and the systematizing of methods of street cleaning.

Under the present system of storekeeping, nothing is issued from the storeroom without a signed order from the foreman or assistant foreman and only enough supplies for the job then under way are issued at one time. The record of supplies on hand is kept on index cards, one card for each item, and shows the price, contractor, when ordered,

Motor Trucks for Removal of Garbage

A western inventor, W. G. Sharp, of San Diego, presents the latest solution of the garbage disposal problem. It involves the use of a motor truck which carries a cylindrical container, and a device operated by the engine for compressing the garbage, extracting the liquid which forms the greater part of the weight and running the same off into the nearest sewer by means of a hose. This obviates the haulage of a large per cent. of the garbage weight and moreover delivers it to the incinerator in a dry condition that saves fuel.

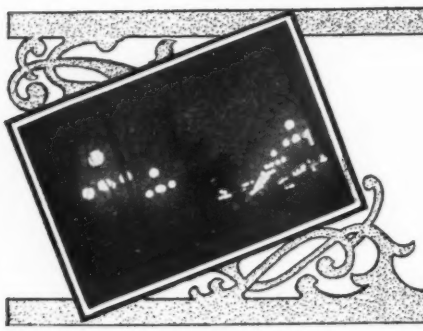
The plan is to build the body of the car of steel in a cylindrical form. Inside of this cylinder, running the full length, is a screw (two or three screws could be used of desired). On this screw is a compressor plate. This screw is revolved with power applied to the forward end, which extends beyond the cylinder far enough to provide for the gearing. Revolving the screw moves the plate, which compresses the contents when driven toward the rear of the wagon, and it is moved back to position by reversing the power. When not compressing, the plate is kept at the front of the cylinder. Garbage is loaded to the truck thru one opening, well up toward the front. The door to the opening is opened by foot levers which give the operator free use of both hands in handling the buckets. It is closed by a spring, so that contents



MOTOR GARBAGE TRUCK *which has a compressor to squeeze out liquids and dumps them into the nearest sewer.*

are never exposed to the air more than a few seconds when actually dumping the buckets. When the car is reasonably full the garbage is compressed. This forces off the liquid, which runs to a separate compartment at the base of the cylinder; to this compartment is attached a long hose, the outer end of which is hung over the rear of the car, and it is closed by a stopcock. When the compartment is full the liquid is run off thru the hose, which is inserted to the base of any sewer or manhole where the wagon happens to be. The garbage will not have to be compressed more than two or three times on a trip, probably, and the liquid run off two or three times. This will depend upon how dry the operator wants to compress the garbage, and the capacity of the chamber which receives the liquir. Garbage will average over 70 per cent. moisture. With a minimum amount of compressing the capacity of a car can be doubled. Auto trucks, tho, will give all the power necessary for compressing, and it may be desirable to compress to the limit. If so, these wagons may perhaps carry three times the load. This is figuring bodies the same size of those now in use, but motor power wagons will probably be built with bodies two or three times the size of those in use now, so that the garbage carrying capacity of a motor power truck with this patent will probably be five or six times that of those now in use, and the work will be done in a sanitary manner. A crew of four or five men could go with each truck, if desired, and it can be kept on the move. Compressing in this way will reduce the odor, as a large percentage of this is in the liquid extracted and, the wagon being water-tight, very little odor will escape from the load.

The unloading feature is simple. The rear end of the cylinder is a hinged door forced tight against a rubber gasket with thrust bolts which may be easily manipulated. At the unloading station this rear door is opened, power is applied to the screw, and the compressing plate scrapes the whole wagon clean. A large hose will then be played into the cylinder and in that way it is kept clean.



Lighting

Municipal Electric Light for Cleveland, Ohio.

For some time the city of Cleveland, Ohio, has been operating two small electric light plants to which it fell heir when the towns in which they had been established were annexed to the city.

One of these, called the Brooklyn plant; has a rated capacity of 1,500 k.w., and the other, the Collinwood lighting plant, of 430 k.w.

The question of the construction and operation of a municipal plant for lighting the whole city has been under consideration for some time and a large plant of 15,000 k.w. capacity is now under construction.

These two smaller plants have been operated to some extent to demonstrate the possibilities of the larger plant. The following results of the operation of the plants taken from the 1912 audit of the books of the department, recently concluded, will therefore be of interest as a means of comparison. The figures for expense in both plants include allowances for interest paid to sinking fund trustees and for depreciation, but the amount of these allowances is not stated.

SUMMARY OF 1912 ACCOUNTS OF TWO MUNICIPAL LIGHTING PLANTS OF CLEVELAND, OHIO.

Property Statement.

	Brooklyn.	*Collinwood.*
Rated capacity, kw.....	1,500	430
Bonded indebtedness....	$30,000	$40,000

	Both Plants.
Total bonds 1900-1902	$70,000.00
Added from earnings to plant value 1900 to 1912	518,930.08
Book value of plants December 31, 1912	$588,930.08
Depreciation to Dec. 31, 1912..	133,552.49
Present value of municipal light plants	$455.377.59

Revenue Statement.

	Brooklyn.	*Collinwood.*
Revenue	$140,313.62	$36,590.48
Expense	93,147.82	34,425.85
Profit	$47,165.80	$2,164.63
Additions to plant value, 1912 ..	$69,466.01	$8,143.65

	Both Plants.
Total added to plant value, 1912	$77,609.66
Cash balance on hand, Dec. 31, 1912	20,834.08

Statement of Product and Unit Prices.

Generated in 1912 kw.....	5,550,384	
Sold in 1912 k.w.....		4,488,917
Average sale price	3.49c	4.30c
Average cost price	2.92c	3.61c
Average profit	0.56c	0.68c

The equipment of the plants is as follows:

Brooklyn:

Two 250-h.p. water-tube boilers.
Two 350-h.p. water-tube boilers.
One 1,333-k.v.a. turbine.
One 500-k.w. turbine.

Collinwood:

Three 125-h.p. fire-tube boilers.
One 175-h.p. fire-tube boilers.
One 350-h.p. Corliss engine.
One 150-h.p. Corliss engine.

In anticipation of the completion of the new plant in the fall a bulletin has been issued giving announcement of a new rate schedule and showing a chart outline of the new rates for both large and small consumers. These rates are as follows:

Schedule No. 1. For resident and business purposes:

No payment shall be less than 60 cents per month.

The first 10 units at 8 cents per unit.
The next 690 units at 5 cents per unit.
All over 700 units at 3 cents per unit.

Schedule No. 2. For picture shows and theaters using over $25.00 per month:

No payment shall be less than $25.00 per month.

The first 500 units or less at $25.00.

All over 500 units at 3¼ cents per unit.

Schedule No. 3. For power; a monthly service rate as follows:

For Three-Phase Current.

Horse Power Rating.

For first 50 h.p. or less 75c per h.p.
For next 50 h.p. or less 60c per h.p.
For next 100 h.p. or less 50c per h.p.
For over 200 h.p. 40c per h.p.

Equivalent Kilowatt Rating.

For first 37½ k.w. $1.00 per k.w.
For next 37½ k.w. or less 80c per k.w.
For next 75 k.w. or less 60 2/3c per k.w.
For over 150 k.w. 53½c per k.w.

No demand charge to be less than $1.50 per month.

For Single-Phase Current.

For all h.p. at 50c per h.p.
For all k.w. at 66 2/3c per k.w.

No demand charge to be less than 50c per month.

Monthly Rate for Current Consumed.

(In addition to the monthly service charge.)

For the first 500 units or less at 3¼c per unit.

For the next 500 units or less at 3c per unit.

For the next 1,000 units or less at 2½c per unit.

For the next 1,000 units or less at 2c per unit.

For the next 1,000 units or less at 1½c per unit.

For all over 4,000 units at 1c per unit.

For Small Horse Power Users.

(With no service or demand charge.)

For 2 h.p. or less, 3 phase, a minimum charge of $1.50 per month.

For each additional h.p. 3 phase, a minimum charge of 75c per month.

For each 1 h.p. or less, single phase, a minimum charge of 50c per month.

For each additional h.p., single phase, a minimum charge of 50c per month.

For all current consumed in excess of this monthly charge, at the rate of 5c per unit.

Under these rates no one will pay more than 3c per k.w.-hour for electrical energy nor will any one receive service for less than 1c per k.w.-hour.

Rates lower than 3c per k.w.-hour will be based upon the capacity of the service connection and upon the amount consumed during any one month. No so-called "flat" rates for less than 3c per k.w.-hour will be granted. The rate which any consumer will pay for current will, if the consumption is large enough, vary from month to month from 3c down to 1c, decreasing with both the size of the connection and the amount used.

How the rates are figured on a sliding scale of consumption.

Thus, if the customer has a 200 k.w. service connection and he uses 20,000 k.w. hours in any one month, his rate will be based upon an average use of his full connected capacity for 100 hours and his rate will therefore be for that month 1.6 cents. If, however, he uses 50,000 k.w. hours in one month his rate will be based upon an average use of his full connected capacity for 250 hours and his rate will accordingly be 1c. This is found on the chart by taking the intersection of the horizontal line from the 200 k.w. service connection with the vertical line representing the average hours used and from this intersection following the diagonal line upward to the right hand side of the chart. Where this diagonal crosses the edge of the chart will be found the figures which represent the rate to be paid.

If the number representing the average hours used is found at the bottom of the chart, then the diagonal must be followed downward instead of upward to find the rate.

The chart represents the rate schedule for a five-year contract. For a one-year contract 10 per cent. must be added to the rates for a five-year contract. Provided, however, that no rate will be over 3c per k.w.-hour.

A minimum guarantee will be required in all contracts of 75c per month for each k.w. capacity of the service connection, but this is not to be added to the bill, it is only a guarantee that the monthly consumption shall equal this amount, and no bill for light or power will be less than 75c per month.

Any one having a five-year contract can discontinue service at any time after one year by the payment of an amount to be determined by adding 10 per cent. to his first year's bills, 7½ per cent. to his second year's bills; 5 per cent. to his third year's bills, and 2½ per cent. to his fourth year's bills.

All contracts for less than one year are upon the same conditions as one-year contracts, except that in addition thereto the consumer pays the cost of the service connection, and any one having contracts for one year or longer may discontinue the use of current at any time within one year under the conditions above except that in addition thereto he must reimburse the city for the cost of the service connection.

The principal reason for the solicitation of power consumers, is that the day load of the plant may be increased; thereby increasing the total output of the plant beyond that possible from the lighting business alone, thus reducing the cost of production per unit.

Consumers having an "off peak" load which can be thrown off during the hours of greatest load on the plant will be given added inducements which will be announced later.

There is considerable capacity for a day load for power from the West Side plants and consumers whose plants can be reached by the present distribution system will be taken care of at once, up to the limit of the capacity of these plants. Others will be given service as fast as possible and those in the districts to be served will be connected in the order in which their applications are filed.

All service for 50 k.w. and over will immediately be given the rates indicated by the chart. Smaller consumers will be given the benefit of these rates as soon as operation at the large new plant at East 53rd Street is started.

Municipal Profits from Gas and Electricity

The gas department of the Bradford Corporation during the financial year ended March 31 last made a net profit on the year's working of $96,089, as compared with $46,806 in the preceding twelve months. The profit was higher than in any year since the purchase of the gas works in the districts incorporated when the city boundaries were last extended. The income of the department last year amounted to $1,642,643, which was an increase of no less than $111,545. The chief items contributing to this result were $27,739 from increased sales of gas and $73,971 from the sales of residuals. Better markets were found for coke, tar, and other residuals.

Owing to the increased price of coal, the cost of manufacture of gas exceeded by about $48,665 the cost for the preceding year, while a new item of expenditure—insurance act contributions—added $2,190 to the expenditures.

After transferring over $34,065 from revenue account toward the cost of the new vertical retorts at the Thornton Road works, there remained at the end of the year a credit balance of $141,464 unappropriated profits, of which $24,332 is to be used for reduction of taxes during the current year.

The net profit on the Bradford city electricity works for the year ended March 31 last was $41,253, an increase of $2,068 on the previous year. The income from the sale of electricity showed an increase of $43,648, and other sources of income made the total increase of $47,701. The cost of coal for generating purposes had increased by $24,111 and the total cost of generation was $170,911, which included $87,446 for coal, $37,389 for repairs and maintenance of plant, and $23,948 for distribution, representing repairs of mains, meters, fuses, etc. The gross profits were $324,805, as compared with $315,388 last year. Interest on loans and income tax consumed $105,185 and $178,367 was set aside to the sinking fund for paying all the debt, leaving, as already stated, a net profit of $41,253. The total number of units sold during the year was 24½ millions, as compared with 22 millions the previous year. Of the total 10½ millions were supplied to the tramways, at a charge of 2 cents per unit. The report also stated that, as compared with the total expenditure on the undertaking of $4,267,920, the outstanding debt was now only $2,444,842.

Municipal Gas Plant at Duluth, Minn.

The city of Duluth, Minn., is fortunate in that it is able to purchase its supply of gas from the Zenith Furnace Co., as a by-product of the method of producing coke for use in making steel. Thus the city simply distributes the gas supplied under a contract fixing its price and quality. The cost of gas is about 41 cents a thousand cubic feet, distribution costs about 11 cents and interest about 12 cents making a total cost of about 64 cents with a consumption of about 325 million cubic feet a year. The aggregate cost has diminished with the increase in consumption from $1.53 in 1899 when the plant was purchased.

When the city purchased the plant the rates to consumers were $1.90 for light and $1 for fuel. They were reduced each year until in October, 1905, they became 75 cents for both light and fuel with a further reduction in 1906 to 50 cents for gas used in heating of premises and in gas engines. These have been the rates until the present date.

The above figures do not include any allowance for depreciation, and the value of the plants is carried at its full cost. It is stated, however, that the surplus earnings of the plant have been expended in extensions and that these surplus earnings have been definitely shown to be much larger than a very liberal estimate for depreciation, so that there is really no deficiency in this regard but rather an excess. The new manager of the plant, S. R. Hatch, recommends a complete classified inventory and valua-

tion of the water and gas plants under his charge and the opening of proper property accounts so that the depreciation in assets and the accession of new assets may be shown clearly.

Mansfield, Mass., Lighting Plant

By George W. Wood, Manager.

The town of Mansfield, Mass., while making no appropriation for the maintenance or depreciation charges of the plant, which are charged to receipts from commercial business, annually includes in the tax levy the interest and bond requirements, which last year were $6,880. The apportionment of the above amount is as follows: Three thousand eight hundred and eighty dollars for interest on outstanding bonds, $1,000 for sinking fund on the $50,000 of thirty-year bonds, and $2,000 to retire two $1,000 serial bonds of the $52,500 serial bond issue. The total number of street lights, figured on a 40-watt basis of current consumed, is 580.

It will be seen by the above figures that all that can be properly charged to cost of street lighting is the amount the town expends for interest charges; viz., $3,880, the balance, $3,000, being the bond payment. The net profit of the plant from commercial business was $5,466.89.

The Massachusetts law relating to municipal lighting plants forbids the sale of current at less than cost, also that its net earnings shall not exceed 8 per cent. In accordance with the above facts, the board has prepared a new schedule of rates to the consumers, reducing the base rate from 15 cents per kw. to 13 cents per kw. and allowing a 10 per cent. discount in addition, on monthly bills, if paid on or before the 15th of the following month. The new schedule is based on current consumed only, and bears no relation to old or existing rates. This reduction applies only to current used for lighting purposes, and does not apply to power, for which a new schedule will also be adopted.

It has been the custom in past years for the town to accept the profit and loss balance, together with interest charges, as the cost of street lighting. It has also been the custom from time to time to add additional street lights, until at present the original installation has nearly doubled. It is still the cost of street lighting to the plant. From a financial showing the plant receives the same; namely, nothing. It is our opinion that the plant should be placed on a proper basis to give a correct financial statement of actual business transacted. To do this, it is necessary that the town should pay a fixed price for each street light installed; and the receipts of the plant should pay all bills, including interest, sinking fund payments and bond retirements.

If the town should pay for what would be the equivalent of 580 street lights, at the rate of $12.00 per light, the same being about one-half the rate charged for similar service elsewhere, the plant would be able to meet all charges, and at the same time make a liberal reduction in the rate to the consumer.

The apparatus consists of a Fort Wayne type QRC, 160-kw., 2-phase, 44-pole, 160-r.p.m., 60-cycle alternator. This generator is direct connected to a 220-h.p. Diesel engine. The alternator shaft has a special extension beyond the outer bearing on which is mounted the armature of a Fort Wayne type MPL, 6-pole, 15-kw., 120-volt direct current exciter; a special extension to the alternator base being provided for the support of the exciter field frame.

During 1911 the street lights were extended on Branch street in accordance with the vote of the town last March. There are now installed 390 40-watt, 32-c.p. lights and 31 250-watt, 200-c.p. lights. The commercial service was extended to East Mansfield. A sprinkler system has been installed thruout the office and basement of the main building. The income from light and power was $21,136.60, an increase of $1,973.82 over last year, or about 10 per cent.

The following data may be of interest:

	1911	1912
Customers	376	460
Meters installed	427	488
Transformers installed	63	69
Horsepower of motors installed	302	310
Street incandescent lights, 200-c.p., 250-watt	31	31
Street incandescent lights, 32-c.p., 40-watt	379	390
Line poles owned	396	447
Miles of street lines	69	75
Gallons of fuel oil used	60,865	66,217
Average price per gal.	$.0265	$.0416

The appraisal value of our plant is as follows:

Land	$ 2,000.00
Building	9,328.46
Engine plant	42,705.48
Electric plant	17,092.74
Electric lines	21,480.75
Transformers	4,973.40
Meters	4,809.20
Street lights	1,546.48
Total	$104,936.51

CONCRETE

Concrete Construction in Dalton, Ga., Water Works.

THE city of Dalton, Ga., recently completed a new water works and lighting system and the power, lighting and pumping plant is situated one and one-half miles from the center of the town on the edge of Mill creek. The data for this description and the photograph are supplied by John W. Ash, of Chattanooga, Tenn., the engineer for the work.

The pumping plant includes a low-head 8-inch motor-driven centrifugal pump, which lifts water from the creek to the coagulating basin and from this point the water passes by gravity thru the filters to the clear water well. From there it is pumped by a 7-inch high-head motor-driven centrifugal pump to the main reservoir on top of Mt. Rachel, which is nearly 300 feet above the creek level.

The power house, coagulating basin, filters, clear water well and reservoir are built of reinforced concrete, the bid for the power house if reinforced being less than the bid for brick construction. The floor area of the power house, including filter, covers about 4,650 square feet. The walls average a little over 20 feet in height, 6 and 8 inches thick, with columns averaging about 11 feet on centers. A beam 12 inches square runs around on top of all walls. The concrete mixture used was 1:2.5:5.

The coagulating basin is 40 feet inside diameter and 10 feet deep. The walls are 9 inches thick and bottom is 4 inches thick. The basin has four wooden baffle walls built of 2-inch plank and 4x6-inch posts. The concrete was mixed in the proportions of 1:2:4.

The clear water well is 40 feet inside diameter, 12 feet deep with 9-inch walls, 6-inch floor and a self-supporting concrete roof, having a rise of four feet at the center, where there is a 4-foot manhole with screen ventilator. The mixture of concrete used was 1:2:4.

The two filter tubs are 15 feet in diameter and 9 feet deep, with a concrete trough around the sides and thru the center. Each filter has six inches of gravel over the strainers, above which is about thirty inches of screened sand. The capacity of each filter is about 500,000 gallons in twenty-four hours. There were no special features pertaining to the basins or building.

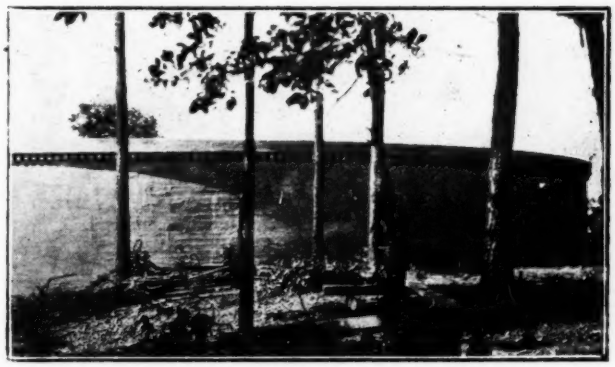
All the materials were brought to the site on a spur track at one end of the building. The mixer was set up alongside the track, the hopper being placed about on a level with the top of a stone car, so that materials could be wheeled directly from the cars. But the material arrived so irregularly that 75 per cent. of it had to be unloaded on the ground and re-handled. The mixer was about at the same level as the top of the coagulating basin and lacked but a few feet of being as high as the highest walls of the power house, so that runways had to be elevated very slightly.

All the concrete was handled in wheelbarrows, the longest distance wheeled being to the clear water well and the coagulating basin, about 125 feet. The bulk of the concrete was wheeled about seventy-five feet.

The main reservoir is 80 feet in diameter, 21 feet deep and has 10-inch walls, with coping floor 6 inches thick. The footing course is 12 inches deep and 2 feet wide. Concrete was a 1:2:4 mixture.

The construction of the main reservoir, which is located on the top of a hill about 300 feet above the creek level, in-

volved some features a little out of the ordinary. There was no road to the top and to have built one would have required considerable time and money. The mixing plant was placed at the foot of the hill and the concrete and other materials were hauled to the top on a tramway. The stone, cement, sand and steel were hauled by wagons from a siding about ⅜ mile away, to which a road and bridges had to be built about one-third of the way. The total length of tramway was about 900 feet and as soon as the track had been laid about a third of the way a double-drum hoisting engine was placed on it and made to pull itself up to that point, where it was set off with the drums facing the track. A ½-inch wire rope was passed around a horizontal sheave in the center of the track. dragged to the top of the hill and passed around another vertical sheave and back again to the foot of the hill hooked to a flat-car which has the back end raised about 2 feet to conform to the average slope of the track.



CONCRETE RESERVOIR *of Dalton, Ga., water works, on top of Mt. Rachel.*

The materials were hauled to the workmen as the track progressed, the pulling line making a good center to work by. The engine was taken part way up the hill for the reason that the empty car returning would not have been heavy enough to unwind the line from the drum and return to the bottom without starting at the top at too dangerous a speed. The latter part of the ascent was at least twice as steep as the first part.

In order to make a trip in the minimum time it would be better to use two lines, a single line from the foot of the hill to the engine and the double line the balance of the way. After a few trips the men became so accustomed to it that they could make the change of couplings in 10 to 15 seconds.

There was ½-yard Smith mixer placed at one side of the track near the end, which was fed from the piles, which were placed far enough up the hill to make the wheeling nearly on a level with the hopper.

The water was procured by digging a large well about 300 feet below the mixer and was pumped into the mixer tank by a steam pump, driven by the same boiler that drove the mixer. The supply was insufficient and some water had to be hauled by wagon.

The concrete was carried in two concrete carts, each cart carrying one batch. While these were being hauled to the top and returned empty two more would be loaded and ready when the empties returned. At the top the landing platform was nearly on a level with the top of the reservoir walls, but as these walls were carried up in 7-foot sections, the concrete was dumped down a chute to a platform on a level with the top of the section, where it was rehandled with wheelbarrows.

As soon as the work of concreting was well started and each man knew just what he was to do, a round trip could be made very quickly. The best day's run was 74 trips in 8 hours, less than 7 minutes to a trip. The average, however, was about 9 minutes, owing to an occasional derailment or other slight delay.

As the top of the mountain is cone-shaped, about 1,650 cubic yards of excavation was necessary to make a site large enough for the reservoir. The excavation ranged in depth from 18 inches to 14 feet. Half of it was a compact clay and the balance loose and solid rock that required blasting.

The outside forms were built by setting 2 by 4-inch studding, spaced 2 feet apart on a template sawed to radius. The inside forms were built in sections 12 feet long and 7 feet high. They were made on the ground ready for setting up as soon as the steel had been placed high enough to receive them. Enough sections were made for two vertical runs.

When the first section had been filled and steel placed 7 feet higher, the next sections of forms were placed and wired; while these forms were being filled the bottom sections were loosened up and made ready for raising to the top. There was a gasoline saw rig used for sawing the inside ribs, jointing and ripping form lumber.

The Capitol Avenue Bridge

By L. V. Sheridan, C. E., Chief Inspector, Board of Park Commissioners, Indianapolis, Ind.

The Capitol avenue bridge, across Fall creek, is the latest of the many fine bridges possessed by the city of Indianapolis, to be erected. Its construction was commenced on June 19, 1911, and the last portion of its construction was completed the latter part of May, 1912. A bridge of permanent character, to replace the old steel truss already in place at this point, had long been projected, and had even reached the point where plans had been prepared, but various causes had interfered and the old structure still stood, an object both unsightly and dangerous. Late in 1910 the Board of Park Commissioners of the city and the Commissioners of Marion County joined hands in its construction, the agreement being that the county should stand $70,000 of its cost and the park board the remainder, which amounted to $30,000.

The conditions governing the design of this bridge were possibly more complicated than is usual. Capitol avenue is the north and south boulevard, connecting the center of the city with the extensive system of parkways planned along Fall creek. The greatest development has taken place at this point and the work is assuming that completed state where it is appreciated by all. It was therefore necessary that some results other than strength should be present. It should seem in harmony with its surroundings and at the same time have a dignity which would be impressive. Suitable curved approach walls were necessary to unite it with the parkway drives on either side of the stream and to destroy the feeling of abruptness occasioned by many bridges whose designers have paid little attention to the architectural features of the design.

The bridge consists of three seven-centered arches, the center one having a span of 84 feet and the end ones spans of 48 feet each. The center arch has a rise of 11 feet 6 inches, and the smaller ones rise of 8 feet 9 inches. Granite, quarried at Mt. Airy, North Carolina, is used for facing the piers and abutments up to the spring line and the first course of the approach walls. It is of a uniform gray color and harmonizes very well with the buff Bedford stone furnished by the Bedford Cut Stone Company, used for the facing above the spring line. The piers and abutments are surmounted by cast bronze cluster lamp standards of special design, and similar standards, slightly smaller, adorn the end posts of the approach walls. A slight camber carried over the structure gives an effect of solidity and completeness which is very pleasing.

The piers, 15 feet thick at the base, and the abutments, 21 feet thick, are carried on 15-foot piles, spaced 3 feet center to center, except in the south pier, in which 20-foot lengths were used. The concrete was mixed in the proportion of one part cement, three parts sand and five parts gravel. The gravel excavated from the foundations was found to be very satisfactory, with the exception of the presence of a slight excess of fine aggregate, which was remedied by the addition of coarse material purchased near by. The arch rings were mixed in the proportions of one part cement, two parts sand and four parts broken stone, and were poured in longitudinal sections. The first end arch to be cast was poured in one section, but as this necessitated working until late in the night, the other was cast in two sections and the center in four. The reinforcing in the arches was very heavy, consisting of sets of upper and lower longitudinal bars, shear bars and transverse bars, as shown in Figs. 2 and 3.

Among the interesting features of the construction was the contractor's plant, which, while embodying no unusual features, was very efficient. At the south end of the work a 60-ft. swing derrick was erected and at the north end a 70-ft., while resting on the center pier of the old steel bridge was an 80-foot. These were all operated with "bull wheels," permitting a swing of practically 360 degrees, and, when lowered, were close enough together for the load to be transferred from one to the other. Mixing plants were erected at each pier and abutment for pouring the lower courses. For the arches a large mixer was placed at the north end of the bridge, and the tracks leading to it were so arranged that the cars were loaded while in motion. The concrete in buckets was carried in cars over a trestle to the point where needed and placed with the aid of the derrick. The piles for both the false work and the foundations were driven with a No. 2 Vulcan steam hammer and were placed rapidly.

The cement used was required to pass the requirements of the American Society of Civil Engineers. A large number of tests were made, and the following are the results obtained:

NEAT TESTS.

Age.	No. tests, Av.	Lbs. pr. sq. in.
24 hours	30	251
7 days	22	540
28 days	13	496
2 months	3	450
3 months	3	840

ONE PART CEMENT—THREE PARTS SAND.

Age.	No. tests,	Av. Lbs. pr. sq. in.
7 days	13	153
28 days	9	223
2 months	3	352

With the exception of two cases, the results are above the requirements, and the low averages in these two cases were caused by the presence of a few damaged briquets, which broke at a small load. Tests for time of setting and the boiling test were performed on the work, and in all cases were up to standard.

The specifications called for the backs of all walls and the tops of arches to be "water-proofed with a mortar consisting of one part cement, three parts sand and the proper amount of Medusa waterproofing compound or its equal." This was used on one arch, but on the other two two coats of an asphaltic paint were painted on, and this was used to back some of the stone, but it gave very poor satisfaction. It had very little adhesive power, and, while it is apparently waterproof in itself, as proven by several tests, it failed to stick to the arches or stone work, and in consequence some leakage occurred. On some of the last walls put up the backs were plastered with mortar water-proofed with 4 per cent. of Medusa, and this has apparently held back all moisture. In consequence of this experience, the water-proofing clauses in the specifications for an arch now building for the department were revised and now call for the spandrel walls and approach walls to be water-proofed throughout with 4 per cent. of Medusa or its equal, and that a ring of the arch two feet thick next to the wall be water-proofed with the same amount. The result is awaited with interest.

The arch, as stated previously, was built jointly by Marion county and the Department of Public Works, and was designed by Mr. George E. Kessler, landscape architect for the Park Board. Mr. Robert C. Barnett had charge of the engineering features and Mr. H. C. Broadwell was the architect for Mr. Kessler. The Cleary-Kuert Company, of Indianapolis, were the contractors. The writer was in personal charge of the work during construction. Lehigh portland cement was used exclusively. The materials used were as follows:

5,520	barrels Lehigh portland cement.
117½	tons reinforcing steel.
960	tons Bedford cut stone.
485	tons Mt. Airy granite.
2,000	cubic yards crushed stone.
4,000	cubic yards sand and gravel.

Conservation of Road Building Funds by Proper Design and Repair

The Office of Public Roads of the Department of Agriculture is making a strong effort to focus the mind of the country on the fact that maintenance and effective repair are of equal importance with the actual improvement of bad roads. Investment of money in new roads does not become real economy until provision is made for keeping these new roads in condition after they are built. If a new road was built and then allowed to fall into disrepair, much of the original investment is simply wasted.

Europe, generally speaking, is ahead of the United States in the matter of road improvement, but Great Britain is struggling with a problem similar to the one that confronts the people of the United States. In England, Scotland and Wales there are no fewer than 2,140 separate authorities who, between them, administer 175,487 miles of roads, or an average of only 82 miles apiece. In Scotland, apart from the big cities, there are over 200 burghs, one-half of which have but 10 miles of road apiece to maintain. Needless to say, such a minute mileage is insufficient to keep the road plant fully occupied all the year around and renders the employment of a skilled engineer impossible for economical reasons.

Officials of the Office of Public Roads, when called upon for assistance by the various states, are pointing out that road building is an art based on a science, and that trained men and experienced men are necessary to secure the best results from the expenditure of road funds.

Statisticians have found that, although the average expenditure on the improvement of roads exceeds one million dollars a day, a large portion of the money in the United States is wasted because of the failure to build the right type of road to meet the local requirements or the failure to provide for the continued maintenance of the improvement.

The various states and counties within the past six months have taken a greater interest in road improvement than ever before in the history of the United States, and there is now a strong movement to conserve the roads of the country where they are improved. Scientific maintenance will be one of the chief features of the work of the Office of Public Roads throughout the present year.

MISCELLANEOUS

The New Home Rule Charter of Dayton, Ohio.

On August 12 the voters of the city of Dayton, Ohio, adopted the new charter which provides for a business manager to take charge of the administration of the city's affairs, to be appointed for his fitness for the work and by an elected commission.

The city of Staunton, Va., is probably the first city in this country to turn the operation of city departments over to a business manager. This was done in 1908, the mayor and the two-chambered city council creating the office and filling it. This was entirely voluntary and could be revoked at any time.

The idea has worked out so well, however, that, not to mention purchasing agents and other business agents for departments of city government, the general plan has spread rapidly.

In 1911 Lockport, N. Y., tried to get a charter which would permit the operation of the city by a business manager and failed. In 1912 the city of Sumter, S. C., under a new law in that state, adopted the commission form of government with a city manager, appointed by the commission and acting under it. The law and the charter are very meager in their provisions but the plan seems to be operating successfully. In 1913 the city of Hickory, N. C., adopted the same plan, the first city council under the new charter being elected in April. Westmount, a suburb of Montreal, Que., is also installing the office of general manager, the first one being appointed in May.

The states of New York, New Jersey and Wisconsin have been considering legislation on the same line and the State of Ohio has passed a law which contains the most advanced ideas regarding municipal government as yet crystallized into legislation. This law is based on a bill prepared by the Municipal Home Rule Committee of the Municipal Association of Cleveland and approved by the Ohio Municipal League, and presents three plans of city government from which cities can choose, preparing their own charters in conformity with the plan adopted. This law thus recognizes very fully the right of cities to rule themselves.

The three plans presented are the Commission plan with three or five commissioners having full charge of legislative and executive departments of the city; the City Manager plan, with five to nine councilmen, one of whom is mayor, having the legislative functions, who appoint a city manager, with full power over the administrative departments of the city government; and the Federal plan in which the elected city council has all the legislative power, and the elected mayor has the executive powers, with the elected municipal judges to exercise the judicial powers.

Des Moines, Sumter and Indianapolis may be taken as prominent representatives of the three plans, and to these are added the home rule principle as perhaps most definitely stated heretofore in the laws of Colorado, but permissible in Ohio under an article of its constitution.

Each city organizing under the new Ohio law is also given the duty of voting upon the adoption of the initiative, the referendum and the recall.

The city of Dayton was ready to take advantage of this law as soon as it went into effect. A charter commission was elected at a special election held May 20, 1913, and immediately presented a form of charter for public discussion, which was put into final form for submission to the voters on June 23. Meantime provisions of the statute regarding procedure in adopting this charter were met and the election for the adoption of the charter was set for August 12 and the system will be put in operation on January 1, 1914, under officers to be nominated September 2 and elected November 4.

Copies of the charter voted upon can probably be obtained of the Bureau of Municipal Research at its Dayton office, 601 Schwind building. A statement of

its most prominent features will be of interest here, omitting features common to all charters and those which are strictly local in their application.

Method of nominating Commissioners.

Candidates for commissioner are nominated by petition of at least 2 per cent. of the registered voters and acceptance by the candidate, the primary election to be held hereafter on the second Tuesday of August of each odd-numbered year. Names of candidates are arranged alphabetically and ballots are printed and put in blocks so that each candidate's name appears at the top the same number of times, the others ranging after him alphabetically around thru Z and A to his initial again. At the regular election, held on the Tuesday after the first Monday in November, the names of those receiving the highest number of votes, not more than twice the number of offices to be filled, appear on the ballots in similar orders to those at the primary. Two commissioners are elected regularly at one election and three at the next, the term of office being four years.

A commissioner may be recalled by an election called on a petition of 25 per cent. of the registered voters, and if recalled the vacancy is filled by the candidate receiving the largest number of votes at the same election, each candidate being required to file a nominating petition of 5 per cent. of the registered voters. The obnoxious official has six months in which to make good after any regular or recall election in which he is successful. The city manager can be recalled by petition and election altho he is appointed by the commission, as is his successor.

Ordinances may be presented to the commission on initiative petition of 10 per cent. of the voters and if the final action of the commission, to be taken within 30 days, is not satisfactory the ordinance must be submitted to the voters on petition of an additional 15 per cent. of them, or 25 per cent. in all, in the form set out in such petition. Proposed repeals on petition follow the same course. No ordinance but emergency ordinances, which are fully defined, can go into effect until 30 days after passage, so that a petition can be filed, if desired, demanding its repeal or submission to the voters. If two or more ordinances submitted to an election are conflicting, the one receiving the highest number of votes is declared adopted and the other is not, even if it receives a majority of the votes cast on it. Emergency ordinances are subject to the referendum but are in operation meantime.

The commissioner receiving the highest vote when three are elected is the mayor for the ensuing four years, the other three members of the commission deciding in case of a tie. The position is largely honorary beyond his duties as a commissioner. He receives $1,800 a year and the other commissioners $1,200. They are docked 1 per cent. of their annual salaries for absence from regular meetings without authorization and a seat is vacated by 5 consecutive unexcused absences. The commission fixes the dates of regular meetings, which must be held at least once each week.

The commission chooses its clerk and other direct employes, and the city manager. It must provide for continuous audit of books of administrative departments and regular statements of condition of accounts, summaries of receipts and expenditures, etc., to be printed and distributed as prescribed.

The City Manager can be a non-resident.

The city manager may be a non-resident when appointed, his political beliefs must not be considered, and he holds his office at the pleasure of the commission or the recall. His duties are

(a) To see that the laws and ordinances are enforced.

(b) To appoint and, except as specifically provided, remove all directors of departments and all subordinate officers and employes in the departments in both the classified and unclassified service; all appointments to be upon merit and fitness alone, and in the classified service all appointments and removals to be subject to the civil service provisions of the charter:

(c) To exercise control over all departments and divisions created by the charter or that may be hereafter created by the commission;

(d) To attend all meeting of the commission with the right to take part in the discussion but having no vote;

(e) To recommend to the commission for adoption such measures as he may deem necessary or expedient;

(f) To keep the commission fully advised as to the financial condition and needs of the city; and

(g) To perform such other duties as may be prescribed by the charter or be required of him by ordinance or resolution of the commission.

Departments, city plan board, and advisory boards are established and may be combined or separated by ordinances of the commission, the general and some specific duties of those of law, public service, public welfare, public safety and finance being prescribed in the charter.

The city manager has the appointment and control of all officers and employes in the departments except certain rights and duties of the fire and police chiefs regarding firemen and policemen and the regulations of the civil service board, made up of three members with six-year terms of office one being appointed each two years by the city commission.

Elective officers not subject to the civil service board.

The elective officers and the city manager are not subject to the civil service board. The city manager can appoint and remove independently the heads of departments, and of divisions of departments, his deputies and secretaries and a deputy and a secretary for each department. Members of appointive boards and the clerk of the city commission are also in the unclassified service.

All other city employes are governed, as to determination of qualifications for appointment or for promotion, demotion, or discharge, by the rules of the civil service board, three classes of employes being set forth in the charter:

(a) The competitive class, includes all positions and employment for which it is practicable to determine the merit and fitness of applicants by competitive examination.

(b) The non-competitive class consists of all positions requiring peculiar and exceptional qualifications of a scientific, managerial, professional, or educational character, as may be determined by the rules of the board.

(c) The labor class includes ordinary unskilled labor.

There are many provisions of details of making improvements and assessments and appropriation of property which seem to be necessary under the Ohio laws. Some rather antiquated methods of procedure are retained, such as notifying property owners to construct or repair their sidewalks instead of treating them like other street improvements. Three methods of making assessments are provided from which choice must be made for each ordinance:

(a) By a percentage of the tax value of the property assessed.

(b) In proportion to the benefits which may result from the improvement.

(c) By the foot frontage of the property bounding or abutting upon the improvement.

Interesting provisions are that the amount of assessment upon any piece of property shall not exceed the benefits to it, and the amount assessed against it in five years shall not exceed one-third its actual value after the improvement is made. The latter is apparently a difficult matter to determine, but it puts the limit at a more equitable figure than the usual provision that the assessments on a piece of property in a year shall not exceed, say, half the assessed valuation of the lot before the improvement. The city is required to pay at least 2 per cent. of the cost of any special assessment improvement and also the cost of intersections, which may be paid from proceeds of bonds not included in the statute limitation of indebtedness of the city. Replacements of street improvements cannot be assessed on the property in excess of half their cost for fifteen years after the original improvement was made. Assessments are made in advance of construction, so that supplementary assessments and rebates are provided for, always troublesome and probably more expensive than borrowing money to pay the contractor or requiring him to wait until the collections are made after the exact cost is ascertained. The commission can provide for construction of improvements by day labor. Bonuses and forfeitures for time saved or lost in completing contracts are provided for.

Franchises are subject to referendum on petition, cannot be exclusive and cannot be renewed before one year in advance of expiration. They must provide price or method of determining price in case city wishes to purchase, which price cannot include the value of the franchise.

A detailed budget is provided for to be reported by the city manager on November 1. Hearings on the appropriation ordinance and publications are provided for and the ordinance must not be passed until the second Monday in January nor until ten days after its publication, altho the fiscal year begins January 1.

The commission fixes salaries of heads of departments, its own employes, policemen and firemen, and members of boards in the unclassified service.

The city manager fixes all other salaries and numbers of employes. The salaries must, however, be uniform in all departments for the same grade of service as classified by the city manager under the rules of the civil service board.

Amendments to the charter may be made by the commission if approved by the voters at an election or by initiative petition of 10 per cent. of the voters if likewise approved.

The success of city government does not depend so much upon the form of the government as upon the real desires and demands of the citizens, but the Dayton plan certainly makes its possible for the voters to determine promptly and decisively what form of government they desire. The voters have but two or three offices to fill at a time and can concentrate their attention upon the ability of the

candidates to become good directors of their business. And if the men elected prove to be incompetent or dishonest, they can be displaced. Very properly, the trouble of displacing them is made sufficiently great to prevent frequent changes in response to whims or sudden changes of opinion regarding men which have insufficient basis in fact.

This is the most promising experiment in city government which has yet been made. It will undoubtedly be tried in other cities before those now having it under way have demonstrated its possibilities of success.

American Road Congress at Detroit

The very attractive program of the third American Road Congress, to be held at Wayne Garden, Detroit, Mich., September 29 to October 4, will occupy practically the whole week, the evenings and the afternoon of Wednesday being given over to social features and the remainder of the time to the sessions, which are distributed among various organizations interested in the congress.

The Monday morning session is introductory with the addresses of welcome and encouragement. The afternoon belongs to the national administrations of the United States and Canada, with addresses by officials and a paper written by President Wilson and read for him.

National legislation will be the subject of the Tuesday morning session under the charge of the American Automobile Association, and the Lincoln Highway Association will occupy a part of the time. Addresses are expected from Representatives Jonathan Bourne, Jr., and Dorsey W. Shackleford and Senator Claude A. Swanson., presenting the various plans for national aid for road building and it is hoped that some definite plan can be agreed upon which the road congress can recommend to the national congress.

The afternoon session, conducted by the American Bar Association, will discuss state legislation and road management. There will be addresses by William D. Sohier, chairman of the Massachusetts State Highway Commission, on the recent International Road Congress in London; by John A. McIlhenny, president of the United States Civil Service Commission, on the merit system in road management; by James R. Marker, Ohio State Highway Commission, on the evolution of road legislation in Ohio; by Henry G. Shirley, chief engineer of the Maryland States Road Commission, on systematizing the purchase of road material and equipment.

Wednesday morning is the engineers' day under the charge of the American Highway Association, at which construction and maintenance problems will be considered. A long list of papers is provided, which papers will be printed in advance and distributed so that they can be read by title only and the time can thus be devoted to discussion of the material provided. State highway commissioners and engineers of Virginia, Louisiana, Maryland, Alabama, Minnesota, New Hampshire, Oregon, New Jersey, Kentucky, Pennsylvania, Ontario, Michigan, Maine, Wisconsin, Iowa, California, Illinois and Massachusetts are on the list of speakers, also the county engineer of Cuyahoga county, O., the chairman of the Baltimore Paving Commission, the director of the United States Office of Public Roads, and several experts upon allied subjects. Unsurfaced, gravel, bituminous macadam, brick, concrete, road construction and maintenance, the labor problem, the handling of working forces, the selection of road materials, dust prevention, drainage structures, conservation of road equipment, systematizing and accounting for purchase and placing of construction and maintenance materials, the merit system in road management, financing road improvement, bond issues, economics of road improvement, California's system, contract law, dirt roads and politics, and the London International Congress, are the subjects chosen by or assigned to the speakers named.

Friday is Michigan day, under the auspices of the State Good Roads Association, with Michigan speakers. The business meeting of the American Highway Association will be held in the evening.

About seventy exhibitors of materials, methods and accessories are announced in advance and the United States Department of Agriculture will exhibit the largest and best collection of models and pictures yet presented.

The American Road Congress has evidently become a short session training school for road officials where they can get full information, see the results and collect a vast amount of literature and instruction at a minimum expenditure of time and money.

American Public Health Association

The forty-first annual meeting of the American Public Health Association will be held at Colorado Springs, Colo., September 9 to 13, under the presidency of Rudolph Hering.

The general sessions will include a symposium on the control and improvement of food supplies with seven papers and at least twenty-five other papers on public health problems.

The laboratory section, F. P. Gorham, chairman, has about twenty-five papers on technical laboratory subjects, including some on water analysis, putrescibility tests, purifying swimming pool water, sanitation of harbors, and a number on bacteriological determinations.

The section on vital statistics, W. S. Rankin, chairman, has a list of eighteen items on its program.

The public health officials' section has a dozen papers or more, including committee reports.

The sanitary engineering section, J. L. Ludlow, chairman, has a well classified program with six papers under the committee on air supplies, on factory and school ventilation, air washing and ozonization; five under the committee on water supplies on sterilization, economies of overdosing of coagulants, softening and decolorizing, corrosion of metals and hygienic aspects; five under the committee on street cleaning on recoverable values of city refuse, night collection, recent progress in methods and results and on contract and municipal labor methods of collection and disposal and accounting.

There will also be several papers on sewage and refuse collection and disposal, on river and stagnant pool cleaning, etc.

The sociological section, Homer Folks, chairman, will have ten papers in three sessions under the general subjects of the sociological aspects of recent reorganizations of health departments, securing funds for public health work, and some economic aspects of health. Selskar M. Gunn, 755 Boylston street, Boston, Mass., is general secretary.

National Paving Brick Manufacturers' Association

The annual meeting of the National Paving Brick Manufacturers' Association will be held at the Statler hotel, Cleveland, O., on September 17 and 18. The afternoons of both days will be spent in the inspection and criticism of brick pavements under construction and in the inspection of some of the older streets and roads included in the thousand miles or so of brick roads and pavements in Cleveland and Cuyahoga county. Prior to the convention, on the 15th and 16th, a party will visit paving brick plants in the vicinity of Cleveland to see what the processes of manufacture are as a basis for determining the practicability of various specifications for paving brick which have been proposed. The city, county and state officials will aid in making the arrangements pleasant for members and guests. A banquet on the evening of the 17th will give opportunity for an exchange of opinions.

The International Municipal League

On the initiative of the Union of Canadian Municipalities, a movement is under way for a union of various organizations of municipal officials and those interested in better municipal government to which the National Municipal League of the United States, the Union of Canadian Municipalities, the Municipal Association of New Zealand, and the National Association of Local Government Officers of England have given their approval. Similar organizations in England, Scotland, South Africa, the United States, Australia, etc., are considering the project favorably. Clinton Rogers Woodruff, North American building, 121 South Broad street, Philadelphia, Pa., is the temporary secretary, pending the completion of the organization.

The Efficiency Society

The Efficiency Society, 29 West 39th street, New York, has an attractive program for the coming season, beginning with a three days' conference at Lake Placid, September 19-21, on efficiency in non-profit-sharing establishments such as churches, hospitals, schools, colleges and the government. In January there will be a three days' conference on profit making industrial enterprises and an efficiency exhibition at the Grand Central Palace, New York City. Dinner meetings will be held each other month, at which will be discussed: In October, analyzing efficiency; November, standard organization; December, progress in scientific management, including financing and business credit system; February, elements of costs; March, mechanical appliances, including freight handling, shipping, packing, cartage and transportation; April, efficiency in the use of supplies, including storage; and in May, home economics.

St. Paul City Planning Conference

For the purpose of developing and promoting the improvement of the city on the lines of the city plans devised by John Nolen, of Boston, and Cass Gilbert, of New York, in connection with his plans for the State Capitol, the Civil Engineers' Society of St. Paul, the Gargoyle Club, the Garden Club members, the Real Estate Exchange and the Women's Civic League have formed the City Planning Conference of St. Paul, which has individual members also.

Seven committees will make the investigations and reports to the conference on city planning; traction lines, railroads and river docks; public buildings,

open spaces; tenants of buildings, relative to street and location, including housing; legal administrative methods; municipal real estate improvement, and taxation.

The business of the conference will be transacted by an executive committee made up of delegates from the component clubs, the officers and the chairmen of the standing committees.

One annual meeting and exhibit will be held by the conference each year, and each committee is expected to provide a program each year for a meeting devoted to its special subject.

Calendar of Technical and Trade Society Meetings

American Concrete Institute. Secretary, Edw. E. Krauss, Harrison Building, Philadelphia, Pa. Tenth annual convention, Feb. 16-20, 1914, at Chicago.

American Gas Institute. Convention, Oct. 15-18, at Richmond, Va.

American Highway Association. Secretary, J. E. Pennybacker, Jr., Colorado Building, Washington, D. C. Meeting at Detroit, Sept. 29 to Oct. 3.

American Institute of Electrical Engineers. Secretary, Frederick L. Hutchinson, 29 West Thirty-ninth street, New York. Meets second Friday. Pacific Coast convention, Sept. 9-11, at Vancouver, B. C.

American Public Health Association. Secretary, Selskar M. Gunn, 755 Boylston street, Boston, Mass. Convention, Sept. 8 to 13, at Colorado Springs.

American Road Builders' Association. Annual convention, First Regiment Armory, Philadelphia, Pa., Dec. 9-12. E. L. Powers, Secretary, 150 Nassau street, New York City.

American Road Congress. Third annual meeting at Detroit, Sept. 29 to Oct. 3.

American Society of Civil Engineers. Secretary, Charles Warren Hunt, 220 West Fifty-seventh street, New York. Meets first and third Wednesday, except in July and August, in New York. Next outside meeting, Oct. 15 to 18, at New Orleans.

American Society for Municipal Improvements. Secretary, A. Prescott Folwell, 50 Union Square, New York City. Annual convention, Oct. 7-10, at Wilmington, Del.

American Wood Preservers' Association. Secretary, F. J. Angier, Mount Royal Station, Baltimore, Md. Convention, Jan. 20-22, 1914, at New Orleans, La.

Federation of Trade Press Associations. Secretary, E. C. Johnston, New York. Convention, Sept. 18-20, 1913, at Hotel Astor, New York.

Illuminating Engineering Society. Annual convention at Pittsburg, Pa., Sept. 22-26. Secretary, I. D. Israel, 29 West Thirty-ninth street, New York City.

International Association of Fire Engineers. Forty-first annual convention, Grand Central Palace, New York City, Sept. 1-6. James McFall, Secretary, Roanoke, Va.

National Paving Brick Manufacturers' Association. Secretary, Will P. Blair, Brotherhood of Locomotive Engineers' Building, Cleveland, O. Annual convention, Sept. 17 and 18, at Cleveland.

New England Water Works Association. Annual convention, Philadelphia, Pa., Sept. 10-12. Willard Kent, Secretary, Narragansett Pier, R. I.

United States Good Roads Association. John H. Bankhead, President; J. A. Rountree, Secretary, 1021 Brown-Marx Building, Birmingham, Ala. Convention, Nov. 10-15, at St. Louis, Mo.

Technical Schools

Bulletin No. 32 of the Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa, contains a report of a topographical survey of the Spirit and Okoboji lakes region by H. C. Ford, the survey having been made by the various classes in civil engineering in the college during the past five or six years.

The plans for the new location of the Massachusetts Institute of Technology have reached the construction stage in part and the Stone and Webster Engineering Corporation have been selected as the construction engineers. The total expenditure on buildings and grounds will be fully $3,000,000.

The New York University School of Commerce, Accounts and Finance, Washington Square, New York, announces a special one-year course in real estate, covering contracts, duties of brokers, taxes and assessments, building loan operations, planning a building, apartment house management, investments, law of contracts, agency, sales and mortgages, etc. Joseph French Johnson, dean.

The Stuyvesant Evening Trade School, 15th and 16th streets, near First avenue, New York, announces a course in structural engineering design to begin September 15, with Sidney Diamant as instructor.

The School of Commerce, Accounts and Finance of New York University, Washington Square, New York City, in its recent periodical bulletins outlines its courses in accounting, finance, law, public affairs, journalism and English, etc., and makes the announcements of programs for the coming school year, beginning September 16.

U. S. Civil Service

The United States Civil Service Commission will hold examinations at the usual places as follows:

Sept. 15: Electrometallurgist in Bureau of Mines, Department of the Interior, at $1,800 to $3,000 a year.

Sept. 17: Examiner of surveys in Forest Service, Department of Agriculture, at $1,200 to $1,500 a year.

Sept. 17, 18: Assistant engineer in forest products in Forest Service, at Madison, Wis., at $1,200 to $1,500 a year.

Edward D. Rich

The first incumbent of the new office of sanitary engineer for the Michigan State Board of Health is Professor Edward D. Rich, who has been assistant professor of civil engineering at the University of Michigan for the last five years. He is one of the few in the corps who retained their places after the recent reorganization of the department. Professor Rich is well qualified by education and experience for the work which has been assigned to him. His engineering work has been upon the water works and in the city engineer's department of Syracuse, N. Y., on the New York state canals, as city engineer or assistant chief engineer of Utica, N. Y., and Summit, N. J., with some railroad experience. He was an engineering student and an instructor at Syracuse University and is a graduate of Rensselaer Polytechnic Institute. Much of his work at the University of Michigan has been in the line of municipal engineering.

Professor Rich is a young man of energy and good judgment and with his basis of training and experience will undoubtedly give his department a high professional standing and usefulness.

Personal Notes

Arthur H. Blanchard, M. Am. Soc. C. E., professor in charge of the graduate course in highway engineering at Columbia University, has been retained by the State Highway Department of Pennsylvania as consulting engineer on the appraisal of certain toll roads, and also as consulting highway engineer by the Department of Efficiency and Economy of the State of New York.

Prevost Hubbard, in charge of the division of roads and pavements of the Institute of Industrial Research, Washington, and lecturer in engineering chemistry in Columbia University, has been retained as consulting highway chemist by the Department of Efficiency and Economy of the State of New York.

Gilmore and Cook, consulting engineers, Binghamton, N. Y., are engineers of the new gravity spring-water supply of Lisle, N. Y., which will include storage reservoirs, and 2¾ miles of pipe, giving 70 pounds pressure for fire protection to the village.

T. M. Hammond has been appointed city engineer of Port Townsend, Wash., to fill the vacancy caused by the resignation of William J. Sadler.

Publications Received

Ninth Annual Report of the Artesian Water Department of Memphis, Tenn., for 1912. Carl E. Davis, resident engineer. Paper, 56 pp.

Report of Frank E. Merrill, Water Commissioner of Somerville, Mass., for 1912. Paper, 43 pp.

Special Report on the Flood of March, 1913, prepared under direction of Dr. E. F. McCampbell, Secretary of State Board of Health, Columbus, O. Paper, 175 pp., being the May number of the Board's Monthly Bulletin.

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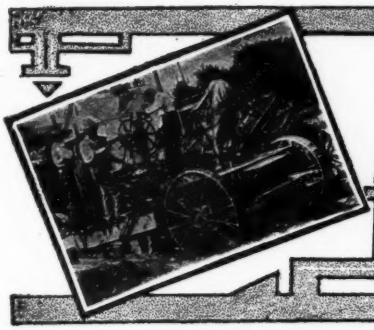


MACHINERY AND SUPPLIES

Expansion and Contraction in Concrete Pavement Construction

By C. G. Allen, C. E.

It is well known to engineers that concrete contracts and expands. Many have assumed that these phenomena are solely a function of temperature changes, but this is not altogether certain. It is a matter of engineering observation that concrete pavement expands and contracts in climates and under conditions where temperature changes are neither frequent nor extreme. Contraction and expansion, irrespective of their cause, act in one of two ways: They rupture the concrete or they induce initial stresses in the material. Irrespective of their causes contraction and expansion have to be provided for and they are now commonly provided for in designing concrete pavements. Long retaining walls are provided with expansion joints or reinforced against rupture by expansion and contraction. Bridge spandrels are invariably provided with expansion joints. Expansion joints are stipulated generally in sidewalk and floor construction. Sometimes they are provided in reinforced concrete buildings, and the reason that they are not generally provided is that building framework is sufficiently flexible to adjust itself to the moderate distortions likely to result from expansion and contraction. It is quite true that expansion and contraction cracks occur in concrete structures of all the kinds named, but this is due to faulty engineering and not to fault in engineering knowledge.

The chief factor, however, which influences the expansion and contraction of concrete pavements is the weather. As the pavement dries out, the top coat shrinks more than the bottom. The effect can often be seen in sidewalks where the contraction has dished the entire slab so that shallow puddles of water stand in them after a rain. As the walk is wet by the rain the top expands more than the base. The alternate bending stresses thus developed all too often show themselves after a few years when the top coat splits off the base.

The necessity of expansion joints in concrete pavements is now well recognized, altho they are put in principally to take care of expansion due to change of temperature. Many experiments on both neat and sand briquettes indicate that the expansion of cement kept wet ceases at the end of a year, and that the total expansion does not amount to over 0.1 per cent.

One of the lately designed and successful expansion and contraction joints for concrete pavements is known as the Thomas System Sure Anchor Edge Protector. These protectors very effectively protect the edge of the concrete and being made of soft steel wear in the same ratio as the surface of the concrete pavement itself. It is impossible for them to wear down any faster than the wearing surface of the concrete, as the traffic affects them in the same ratio as the wearing surface of the street. These protectors are equipped with S-form hooks made of round steel placed at regular 10-inch intervals along the plate which anchor the plate firmly along the edge of the concrete surface. Inasmuch as these S-shaped hooks penetrate into the mass of concrete to a distance of 5½ inches there is no chance for the plate to move from its proper position. These sure anchor protectors are patented and furnished by the Thomas Steel Reinforcement Co., Detroit, Mich.

A Modern City Jail

The longitudinal and floor plan sections herein illustrated were planned and built for Salt Lake City, Utah, by the Van Dorn Iron Works Co., Cleveland, Ohio.

The building is of brick, with floors of I-beam and concrete construction, the cell room having steel stairs and ceilings, thus making it an entirely fire proof structure.

The basement contains the kitchen and serving room, from which it is possible

to feed all departments by means of a dumb waiter.

The drunk cell, which is a very important feature, is conveniently situated, being remote from the various departments so as to make it impossible for noises to be heard elsewhere. In the rear part of the basement is located the cell room, containing cells for vagrants and "sobered-up" drunks; this department is entirely isolated from the department above. We have also provided a prisoners' laundry for their use; also a store, coal and boiler room.

The first floor is very convenient in every respect. The prisoner upon being brought in, is taken to the sergeant's room, where he is searched and registered, after which he passes directly into the main cell room and is taken to his assigned cell. This cell room contains three tiers of cells of the most up-to-date construction, of which each is provided with one prison water closet and two bunks. Each water closet has its own vent, and in addition each of the cells has vent registers near the floor and ceiling which connect into the diagonal vent shaft as shown.

The cells are equipped with the celebrated "Van Dorn Sliding doors and Lever-Controlling Mechanism," which is operated from the entrance corridor, thus insuring the safety of the turnkey. In the prisoners' corridor is a sink supplied with hot and cold water. The floors of these cells are made of steel with 3-inch concrete dressing on top.

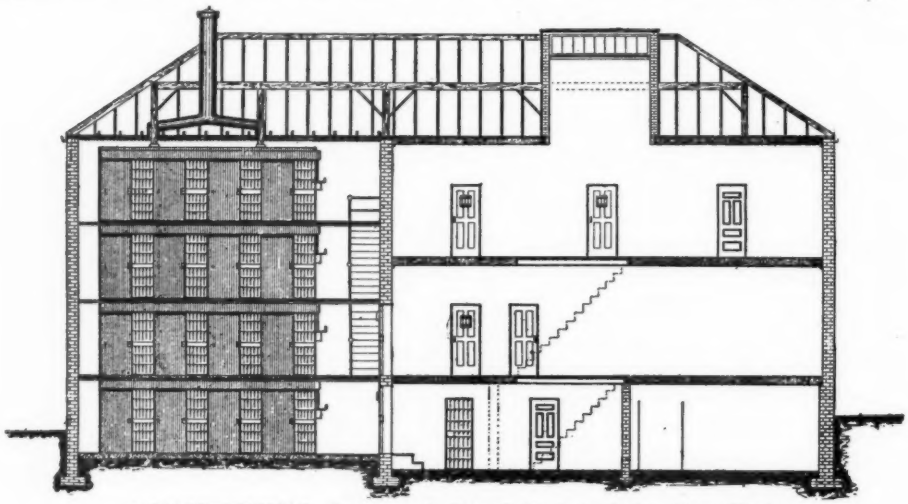
The two burglar-proof cells in the second tier are constructed of the Van Dorn "White Diamond Steel." In front of this cell room is located the bath room, containing shower bath and sink supplied with hot and cold water. The various tiers are reached by means of iron stairs.

The emergency hospital is located near the entrance and is used for city accidents.

The juvenile department contains five cells of similar construction as used in main cell room. This department has also all modern conveniences.

The special department is made up of the insane or padded cell and the dungeon cell, which are especially constructed for their own purposes.

The second floor contains the feminine and minor female departments. The female cells are constructed of Bessemer steel and provided with all conveniences; the minor female department contains two iron bedsteads. A bath room is provided for the use of these two departments. On this floor are located the matron's and jailer's apartments, which are provided with all conveniences.



LONGITUDINAL *Section of City Jail, Salt Lake City, Utah.*

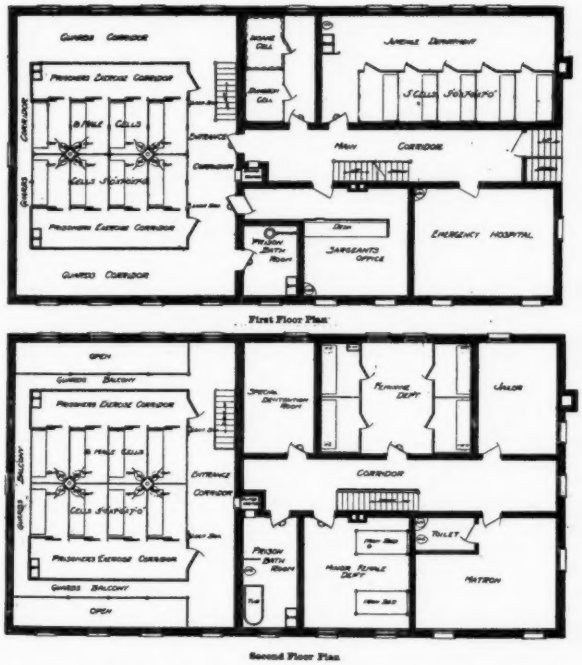
All windows are barred by the "Van Dorn Guards"; all various department entrance doors are made of steel and secured with strong locks and anchor bolts set into the masonry.

All departments are provided with drains so as to allow the free use of the hose for cleansing purposes. The ventilation is of the most modern system.

All departments are well lighted, as are also the halls, having skylights in roof, as shown in longitudinal section.

The question of providing for small towns, and for substations in the large towns, a cheap and neat appearing and also substantial lockup, one that is fire proof and secure and that can be kept in good sanitary condition, has been difficult

to accomplish. The old ways, either to build a wood structure with brick or stone cells, or a brick building with more or less woodwork in connection therewith, without ventilation or sanitary provisions, have been open to much objection. In some places rooms in city halls or other public buildings have been used for this purpose, but the unsanitary condition of these cells has always been a nuisance, not only to the prisoner himeslf, but to the entire building. The Van Dorn Iron Works Co. also manufacture strong and durable steel fire proof and well ventilated lockup buildings. These cells are of steel and are separated by plate partitions with plate sides, ceilings and floors. They open into a front corridor, to the steel floor of which is securely riveted a stove, the pipe extending into the ventilator. On either side of the corridor is a seat which can be used for a bunk in case of overcrowding.



PLANS *of first and second floors, City Jail, Salt Lake City, Utah.*

The main point in the building is that all the walls are made double, with a system of ventilation which insures a warm building in the winter and a cool one in the summer. Not only are the sides, back and front double, but the ceiling as well; the ventilation taking the cool air from the floor, carrying it up thru the sides into the double ceilings and out thru the ventilator. In the cool weather the stovepipe rarefies the air, thus giving the necessary drafts. The only wood about the building is the sash and strips between the walls, and with any amount of carelessness, fire from the stove or surrounding buildings cannot damage the building to any extent or jeopardize the safety of the inmates. The building can be adapted to set upon any plot that is convenient to the officers. It gives a very neat and tidy outside appearance; the windows are so secured, and high up from the ground, that they are not accessible to the outsider.

Asphaltic Concrete in Racine

By P. H. Connolly, City Engineer, Racine, Wisconsin.

Our experience with asphaltic concrete pavement is limited, due to the fact that we laid none of this pavement prior to the year 1911, at which time we laid an experimental strip of Sarcolithic rubber pavement on Ninth street, from Washington avenue to Center street, a distance of 713.3 feet, or 2,298.73 square yards, exclusive of gutters. The cost was $1.90 per square yard. This pavement consisted of a 5-inch portland cement foundation, 1-3-5, a 2-inch layer of stone and Sarco asphalt mixed and thoroly rolled, a skin coat of asphalt and then crushed granite screenings rolled into this skin coat. It has never been repaired, and has never been cleaned, and yet it is clean and free from dust most of the time. This is due to the fact that there is about a 5 per cent. grade on each end of the pavement, the low point being about half way between the ends. The traffic consists of light vehicles and automobiles with very few heavy traffic teams. This experimental strip, which was laid by the Western Improvement Co., of Racine, Wis., has proven so satisfactory that we will undoubtedly lay more yardage in the near future.

The subject of street pavements has become so important, such enormous sums being spent annually for their maintenance, that the utmost intelligence is required in their laying, both from an economical and utilitarian standpoint. Too much attention, therefore, cannot be given to street pavements, covering as they do so large a portion of a well built city.

They should be selected and constructed with the greatest care and when once completed, watched over and repaired, whenever necessary, in an intelligent manner. It is in this way, and only in this way, that our streets can be maintained in the condition that their importance in the make-up of a city demands.

Location and Setting of Water Meters

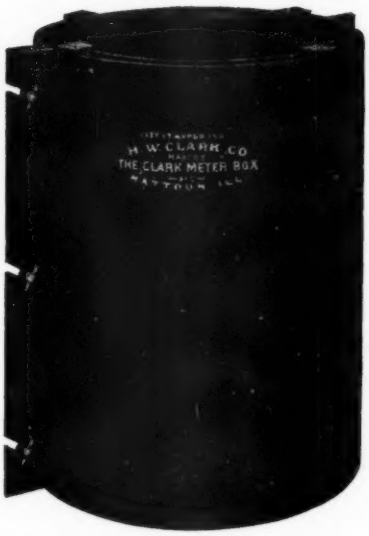
By H. M. Lofton, Superintendent Water Works, Chattanooga, Tenn.

The proper installation of meters is one of the most important elements in successful water works management and, as a general thing, entirely too little attention has been paid to this very important part of the water works equipment. The questions of reading meters, testing and repairing are of great importance, and all of these elements should be taken into consideration in both the location of the meter and the type of meter box used.

New Orleans has 40,000 meters installed under one standardization of setting, which has resulted in a very high efficiency of operation and a low maintenance cost. It has also resulted in reducing the cost of reading meters to a minimum, and in putting the full control of meters in the water department, where it properly belongs.

For the general run of metered services the meter should be set in the sidewalk in front of the premises to be served. This permits of the meter being absolutely under the control of the water department and it also makes their control susceptible to such rules and ordinances as may be passed for this purpose. When set in this way, a meter reader can read from two to three times as many meters as he can where they are set in private grounds or in cellars. Likewise, the work of testing and repairing can be effected much quicker and more economically. In the same way the possibility of tampering with the meter is very much lessened when set in the sidewalk, for the reason that one so inclined will not take the risk of tampering with the meter out in public view. Meters set in cellars or private premises are not only more subject to being tampered with but they are unhandy for reading, testing and repairing, as the premises are often locked, making several return trips necessary for the purposes mentioned, which in turn causes delayed water bills, with consequent disputes over their correctness. Even in the coldest climates, meters should be set in the sidewalk, for in this way freezing can positively be guarded against, which is not always true when they are set in cellars and basements.

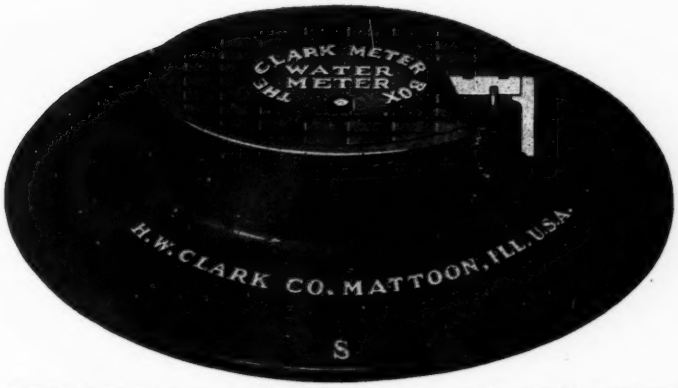
Meters should be set at such a depth that the dial will come within 15 inches to 20 inches of the surface of the sidewalk. No matter how cold the climate may be, this practice holds good, as it has been proven beyond a question of doubt that if the proper meter box is used and the meters are properly installed, there is not the slightest danger of the meters freezing when set at the depth just mentioned. The particular types and methods of setting meters that will accomplish this result, even in the extremely cold climates, will be referred to later in this article.



STRAIGHT IRON *collapsible form, for making of concrete mixer boxes.*

As to types of boxes best suited for general requirements, they should permit of a proper adjustment in height, so as to bring the top level with the surface of the sidewalk, and whether the casing is of concrete, sewer pipe, or iron, it should be provided with an outer iron rim at the top that will permit the sidewalk paving to be joined solidly with it. The box should also be of a type that will permit the meter to be removed and replaced easily from the surface of the sidewalk without the edges of same coming in contact with the sidewalk paving.

If the cover is equipped with a locking device, it should be free from all trifling and complicated mechanism or such parts as might become inoperative thru corrosion, or that would loosen from vibration due to pedestrians walking on the covers. Where the cover is not provided with



METER BOX *cover sufficiently large to easily admit workman.*

locking device it should be fitted into a deep socket and have a deep ring or deep lugs that would prevent the cover from being easily displaced and that would also require a vertical lift with some special lifting device in removing the cover. There are many worthless locking devices on the market; and as a general proposition, the cover with deep lugs has proven the most satisfactory in service.

The above cut illustrates a type of covers and lids designed by the H. W. Clark Co., to meet the demand for a cover having sufficiently large opening for a workman to enter the meter box without the necessity of digging up the cover, but also fitted with a lid of simple and secure locking type. As shown in the illustration, the 20-inch lid for this cover is provided with an 8-inch opening. Thru this opening, meter readings are easily taken; also the locking device provided for securely fastening the large lid to the cover is very easily operated. When it comes necessary to remove the meter from the box, this is very readily accomplished by simply removing the earth overlying the cover and lifting cover off the meter box, which allows an opening the full size of interior of the box body and without in any manner damaging any part of the installation. This in itself is a decided advantage over the ordinary arched brick pit construction in which it is necessary to partially tear down the masonry to remove meter.

Motor Trucks in Street Paving Work

Substantial economies in the hauling of paving material and supplies have been effected by the Warren Brothers Co., the well-known paving contracting firm of Boston, with two White trucks of five tons capacity and one of 3,000 pounds. In less than a year's experience and without materially changing the facilities that had been developed for horse service, the officers of this company have reduced their hauling costs 33 1-3 per cent., and have placed their order with the White Co. for three additional trucks.

Ten of the twelve horses that were formerly maintained in their big Cambridge yards have been supplanted, and a considerable part of their wagon equipment has been adapted to the use of trailers, with satisfactory results. In addition, the officials are satisfied that they can further reduce their hauling costs by making some changes in their yard facilities, to meet the new conditions of transporting and loading.

The company maintains two asphalt refineries in California and the asphalt is shipped by rail. Crushed stone arrives in railroad cars, cement is delivered by rail or steamship, and gravel reaches the yard in barges from Long Island. Many contracts are made for work in cities and towns quite distant from the Boston institution, and in such cases the necessary equipment and tools are shipped and transportation units are hired. The Boston installation, however, is a permanent institution and the facilities of the Cambridge plant have been developed to meet the requirements of street paving, side walks, buildings, flooring and roofing, in Boston and vicinity.

Gravel is stored in elevated bins or pockets and discharged by gravity, asphalt is unloaded from a spur track, and crushed rock is hauled by an inclined cable railroad, all of which tends to show that the material which is stored in quantities is handled scientifically, and the plant has been improved in practical ways to facilitate the receipt and distribution of material as required for contract work.

When horses were used exclusively, the operations of the company were limited to a ten-mile radius from the center of of Boston, and the greater part was inside a seven-mile radius including about seventeen adjacent cities. This limit of

carting distance has been due to the fact that the bitulithic surfacing material, which is composed of certain proportions of crushed stone, gravel and fluid asphalt, is mixed at a temperature of 300 degrees in the Cambridge yard, and must be loaded, hauled and dumped before it cools.

The work can be done only in dry weather, making it necessary to have the hauling done as expeditiously as possible. It must be delivered in practically the same consistency as when it is unloaded from the mixer into the dumping body of the truck, and it is also necessary to have a sufficient number of men at work on the paving job to handle the surfacing when it arrives. It is therefore a proposition involving mixing, loading, hauling and dumping with the minimum loss of time.

With several jobs in progress at the same time the utmost reliability is demanded of the trucks. It is apparent, therefore, that losses of time which are inseparable from any animal installation, mean a considerable loss of money. On the other hand, the company figured that a motor truck, in order to be preferable to horses must actually earn $15 a day.

Careful figures which have been compiled by the company, covering both horse and motor truck installations, show that each White truck did the work of three two-horse teams and occasionally four teams. When trailers were used the trucks supplanted five and six teams, according to the character of the work and the distance of the haul. The use of trucks, furthermore, extended the area in which paving contracts could be made, and on one occasion a contract was performed in Haverhill, thirty-eight miles distant. The trucks were used to carry tools and equipment both ways, saving freight charges and considerable time. The trailers, in addition to hauling surface material, carried the portable furnaces and heating material.

Both of the dump trucks are built with sheet steel bodies of special design, but they are elevated by the standard White power dumping mechanism, which allows an angle of 45 degrees. The bodies are 11 feet long, 6 feet wide, and 18 inches deep, having a capacity of 100 cubic feet. The paving material weighs about 100 pounds to the cubic foot, making a full load exactly 5 tons. The 3,000-pound truck is fitted with a regular stake platform body.

WHITE *five-ton truck in use by Warren Brothers Company, Boston, Mass.*

The Pneumatic Tire

By Chas. E. Swingley, Chief of Fire Department, St. Louis, Mo.

From all the information I could secure in conversation with manufacturers and users of different types and styles of tires, both solid and pneumatic, I have come to the conclusion that under certain conditions and circumstances the solid tire is preferable, and under other conditions the pneumatic tire is advisable. If a high speed is desired, it is necessary to have your apparatus equipped with pneumatic tires, as I am informed that about twenty to twenty-five miles an hour is the limit of speed that it is safe to run on solid tires, unless the streets are free from depressions and projections or high street crossings. In that case, a speed of

about thirty miles an hour may be obtained with safety.

As to pneumatic tires, while there is no limit as to the speed that you can run on them, or say from fifty to sixty miles an hour over all kinds of roads or streets, the mileage per tire is less than that on solid tires.

Then there is a limit to the weight that can be carried on pneumatic tires. Just what that limit is, I am not prepared to state, as it still seems to be undecided by manufacturers and users of tires.

The expense incurred by the replacement of the pneumatic tire seem to be the greatest objection to them. Such being the case, I am informed—and I think truthfully—that the solid tires will cause an addition to the repair account, which in the end would about equal the cost of maintenance.

When we consider the saving to a city by the use of automobile fire apparatus, of which I will give you my experience, we ought not to consider too seriously the cost of tires.

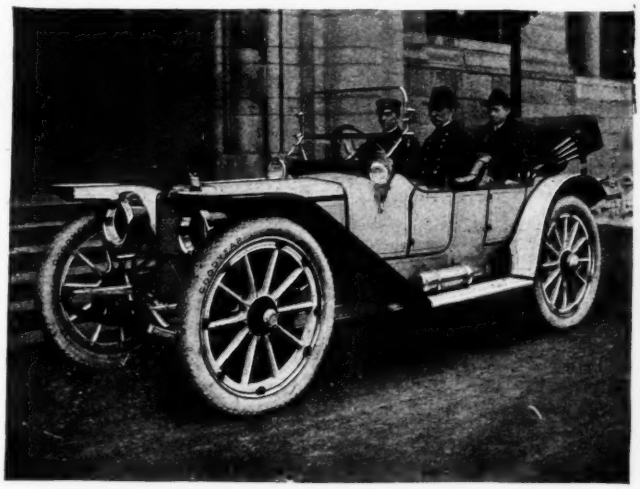
Now, for the first twelve months our automobile fire engine was in service, it covered a distance of 1,163 miles and pumped sixty-four hours, consumed 478 gallons of gasoline and forty-two gallons of lubricating oil; which, compared to a company equipped with horse-drawn apparatus, is a reduction in the expense of maintenance of practically $4,500; and then the automobile company covered three times the distance of the horse-drawn company.

The fact that the automobile can cover a much greater distance in much less time than the horse-drawn apparatus, gives us the desired results, as it is quick time and quick work in reaching a fire that every city and town is trying to accomplish, as you know too well that a fire never waits for your arrival.

With that object in view, are we justified in curtailing expense at the cost of efficiency of the apparatus, or if pneumatic tires cost more than solid tires and give higher efficiency, should the difference in cost, if any, be considered?

There seems to be a desire on the part of tire manufacturers to acquire something that will eliminate tire trouble, and I have seen several devices and preparations that great results are claimed for.

Our chief's car is equipped with Goodyear double-thick, non-skid tires, which are giving excellent satisfaction. This type of tire is also giving very satisfactory service on fire truck, being oversize and having an extra thick tough tread which is vulcanized to the regular tire. These blocks prevent skidding, as they are thick and deep cut. This extra tread is so tough that the tire stands a lot of abuse, and aside from possessing great non-skidding properties is almost proof against punctures. The blocks on this extra tread are set far enough apart to grip and set pavement, but they are not so widely distanced but that the load is evenly distributed over the tire.



CHIEF SWINGLEY'S CAR, *St. Louis, Mo., equipped with* 41x4½ *Goodyear Non-Skid Tires.*

Classification of Water Consumption

By Otto F. Poetsch, Superintendent of Meters, Milwaukee, Wis.

In the past, the department has had to buy or have cut thousands of nipples and connection pipes. By installing a new pipe cutting machine, we are able to cut all these ourselves, thereby cutting down the price of these nipples more than half. Furthermore, a large amount of useless old pipe is recut, so that it can now be used. We operate a complete stock-room, in which all meter repair parts, tools and supplies are kept, properly separated and labeled. The stock room is in charge of a competent stock clerk, who receives all the goods bought, reporting same on proper blanks daily, in order that the bills for same can be correctly checked. A re-

pair order is issued for each meter that comes to the shop for repairs. If a repair man needs any repair stock in order to repair any meter he can get it by presenting the repair order for the particular meter to the stock clerk. The stock clerk charges the parts on this order and also checks out of stock the parts given out, entering same on his list against the particular order number. This list, showing what stock left the stock-room, is sent to the superintendent of meters, daily, for approval, when it goes to the cost clerk in the general office, in order that it can be properly charged and billed.

One hundred of the largest consumers paid $402,563.25, nearly 50 per cent. of the entire revenue received for water, during 1912.

Following gives the classification of metered consumers for the year 1912, the payments being per year:

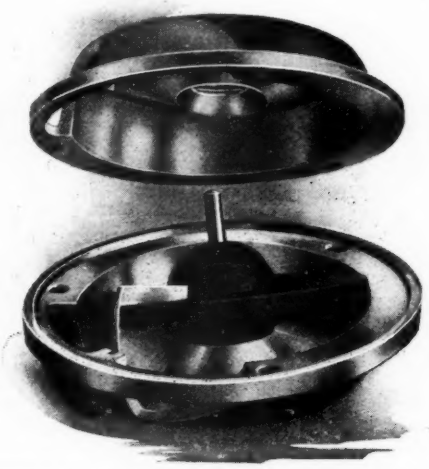
		Per cent.
1,185	less than $0.50	2.10
6,347	between $ 0.50 and $ 1.00	11.00
15,182	between $ 1.00 and $ 2.00	26.33
10,656	between $ 2.00 and $ 3.00	18.48
7,157	between $ 3.00 and $ 4.00	12.41
4,899	between $ 4.00 and $ 5.00	8.50
8,017	between $ 5.00 and $ 10.00	13.90
2,228	between $ 10.00 and $ 20.00	3.86
598	between $ 20.00 and $ 30.00	1.00
271	between $ 30.00 and $ 40.00	0.47
167	between $ 40.00 and $ 50.00	0.29
376	between $ 50.00 and $ 100.00	0.65
428	between $100.00 and $ 500.00	0.76
66	between $500.00 and $1000.00	0.11
80	$1000.00 and over	0.14
57,657		100.00

Beginning January, 1901, a test was begun on water meters that extended thru to 1907. During that time about 10,000 meters were tested.

All meters in service before being set are given a serial number. The start was made with the first meter, beginning with No. 1, and continuing consecutively. The first meters were set in 1882. This test was made on the first 10,000 meters set and included every meter that had not been retested within five years. For the purpose of showing the results of this test, we divide all meters into two classes: Piston-plunger meters and disc meters.

The first 6,000 meters numbering from 1 to about 6,300 were all piston-plunger meters, of the Worthington type. From that time on, in about 1891, mostly disc meters were set, the majority of which are of the Niagara type. The test on the piston-plunger meters was started with No. 1 and extended thru to No. 6,300. These meters were set in service from 1882 to 1891 and at the beginning of test had been in service from 15 to 23 years. Most of these had never been taken off.

Test was made by variation in weight. A tank was placed on a platform scale and 10 cubic feet, as indicated by the meter counter, were drawn into the tank and then weighed, the proper weight for 10 cubic feet being 625 pounds. If the trial



DISC METER *opened to show simplicity of mechanism.*

quantity of water drawn thru the meter weighs more than 625 pounds, the meter is over or in other words it under-registers, and if it weighs less, the meter is short or over-registers.

The result of test on piston meters, as far as could be ascertained, is as follows:

Total of 1689 meters tested, 108,939 pounds over.

Total of 1635 meters tested, 41,339 pounds short.

Total of 107 meters tested, O. K.

Total of 80 meters, did not test.

3,511 meters showed difference of 67,600 pounds over.

Average of 19.7 pounds over, each, or 3.15 per cent. under-registering.

The test of disc meters included those numbering from about 6,300 to 14,000, being set from 1891 to 1895. These meters had been in service about 10 years at the time of test, most of them never having been retested during that time.

The result is as follows:

Total of 835 disc meters tested, 9,189 pounds over.

Total of 952 disc meters tested, 8,474 pounds short.

Total of 168 disc meters tested, O. K.

Total of 52 disc meters, did not test.

2,007 disc meters showed difference of 715 pounds over.

Average of 0.36 pounds over, each, or .057 per cent. under-registering.

It will be seen from the above that the piston-plunger meter made a poorer showing than the disc meters. This is due to the fact of construction and working of meter. The piston was duplex in construction, similar to a duplex piston steam pump with two brass pistons or plungers working back and forth in two brass rings encased in the cylinder or body of the meter. The pistons move forward and backward, alternately, and the stroke of each is counted by means of a lever, which sets between one of the pistons and extends to the counter. The constant movement of the pistons on the rings wears them very gradually. As soon as worn, the water will pass between the piston and rings, which does not record on the counter, thus giving more water than it records.

The disc type of meter has a saucer or flat shaped hard rubber disc, which works within a brass chamber thru which the water must pass. The nutations of the disc of a ⅝-inch meter at about 300 revolutions to a cubic foot are, by means of a pinion shaft connected to a train of gears, recorded on the counter in cubic feet. When this meter becomes worn by the water passing thru, it does not lose in registration, but will, when sufficiently worn, stop registration entirely. This, of course, would be detected very easily by the meter-reader when he comes to take his monthly reading. Same is reported and promptly repaired.

Summing up briefly, the fact is evident that you cannot determine whether a piston-plunger meter under-registers after being in service a number of years. The amount of water passed and recorded by the meter will, of course, be of great use, Take for example a meter set 25 years and consumption only 2,000 feet a year or 50,000 during the entire period. It would be safe to presume that the meter is still correct. Take another meter set 3 years and consumption showing 100,000 per year. From this consumption it would be very evident that the meter needs attention, as that amount of water would wear the meter. The disc type of meter on the other hand will generally record correctly until something breaks or is worn out, entirely, which will stop it from registering at all.

Tile Pipe Sewers Near Chicago

By Herbert E. Hudson, Division Engineer, Board of Local Improvements, Chicago.

The provision of proper sewer facilities for its rapidly growing population is one of the greatest engineering problems which confronts the city of Chicago. There are many interesting points that might be covered in a discussion of the subject which would lead into questions that would concern both the state and the nation, and even reach out to international problems if the work of the sanitary district of Chicago were included in the scope of the study.

However, the problem that approaches closest to the owner of property lying within the city limits is the disposal of household sewage wastes by the quickest and most economical method. Most property owners are willing to allow the broader scientific questions concerning ultimate disposal of the city's wastes to rest upon the shoulders of the municipal au-

THIRTY-THREE-INCH *vitrified sewer pipe ready for installation in Chicago suburb. Shown through courtesy of Blackmer & Post Pipe Company, St. Louis, Mo.*

thorities and their consultants. Their interest, however, is aroused when they are confronted with the proposition of installing a sewer immediately adjoining their property.

This interest seems more or less lukewarm among the owners in Chicago and there are very few owners who have ever made it a point to thoroly investigate what was being done along these lines or why it was done any particular way. Owners of property abutting upon sewer improvements in Chicago are more prone to complain of the condition of the surface of the street during the progress of the work and after its completion than to investigate the actual methods of design and construction of the work itself.

There are, I believe, several reasons which control this lack of interest. First, the design of any sewerage system is very technical in its nature and therefore not easily explained to or understood by the ordinary layman. Second, the construction is more or less complicated by all the different appurtenances, such as manholes, catch basins, slants, house drains

and household sewerage systems. Third, and perhaps most evident, altho least valid of all, is the fact that upon completion the whole work is covered and therefore out of sight.

The extension of Chicago's sewer system into its outlying districts has several phases that are not evident upon cursory investigation. The growth of the city has compelled the extension of the sewer system at such a rapid pace that the only satisfactory method of financing these extensions is by special assessment. If the large systems were to be paid for from the general fund, it would require an enormous increase in the general taxes. As the improvements and their benefits are local in their nature, the application of the special assessment or special tax is entirely just. However, the engineer of the board of local improvements, in making estimates, is confronted with the problem of providing mains and laterals at a cost which will not be too burdensome upon the property owners or excessive as compared with property values. These restrictions can easily lead to errors that will later become serious. First, insufficient mains or laterals may be provided. Second, insufficient provision may be made for the future growth of the population of the district under consideration. Third, the annexation of suburban property may make additions to the drainage district and produce conditions that cannot properly be met under a strict compliance with the special assessment laws of the state of Illinois.

The first error is a false economy upon the part of the engineer. Health conditions may demand the installation of sewers in district that will require the building of large mains. The costs of these mains, coupled with the cost of the lateral systems, may be excessive as compared with property values. Economy in the construction of these systems may be justifiable in many cases but will surely result in an expensive rebuilding of the systems later.

The second is a question of judgment, or, perhaps a thoro study of population conditions. The sewer systems designed for the old town of Lake View and many other portions of the city are suffering from improper provision for population growth. The construction of flat buildings and intensified housing facilities have produced conditions that it was almost impossible to foresee. Chicago today is replacing many of these inadequate sewers with newer and larger systems. By the use of the large intercepters and sewage pumping stations, better depths and gradients are obtained. In many cases, the sewers in the streets are being replaced by the same size, or in some cases, smaller sizes of tile pipe sewers that offer better drainage by virtue of these intercepters, coupled perhaps with a more competent design. The writer has had charge of the removal of several systems which were taken up to make room for the installation of both intercepting sewers and lateral systems draining into them. These sewers were removed simply to provide for the larger sewers and to take advantage of the better depths offered to the lateral systems, and in many cases, tile pipe sewers which have been laid for twenty-five or thirty years, and which were in perfect condition, were removed.

The third error in which the engineer may find himself is one that cannot properly be handled under the existing legal conditions. It is noteworthy in this connection that two or three of the suburbs of Chicago have made the sewerage problem a basis of argument for annexation to the city. Under existing conditions, these arguments are especially good and they should receive much consideration by the suburban towns, particularly when the town sites lie within the water sheds of the Chicago systems.

Securing the Proper Mix

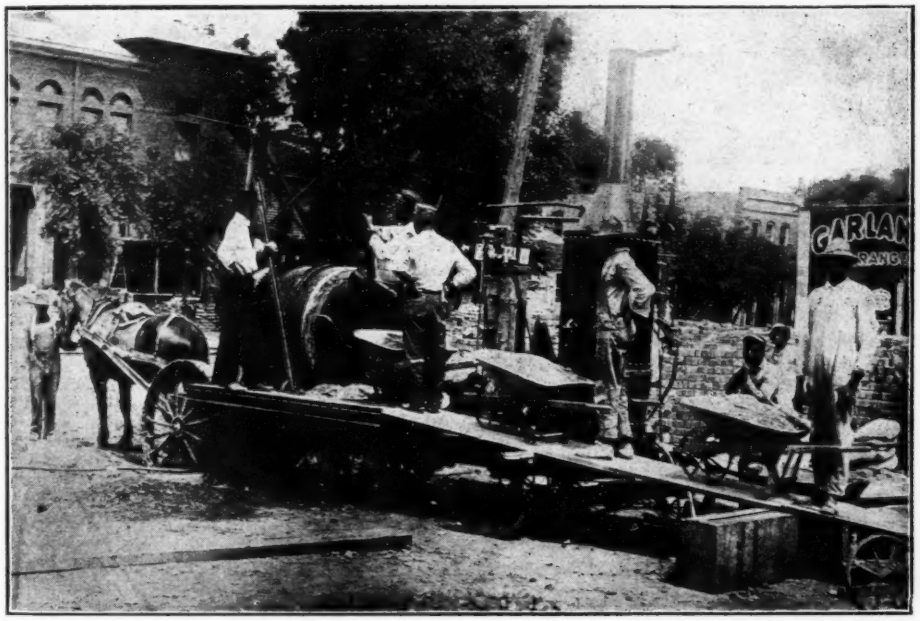
By Ritchie Brothers, Contractors, Topeka, Kans.

One explanation to be offered for failures of concrete roads due to disintegration or raveling under traffic is probably as much a lack of mortar in the concrete as a lack of cement in the mortar. The conclusion from observation is that with a given aggregtte there will be little difference between roads built in proportion of 1, 2½, 5; 1, 2, 3, or 1, 1½, 3, for in each instance, assuming that the aggregate runs precisely the same, there is but 50 per cent. mortar, and where a 1, 2, 3 mixture might have given unsatisfactory results, this condition would not be greatly bettered by using merely a richer mortar. What should be done is to increase the per cent. of mortar. For example, instead of 1, 2, 3 mixtures, to use 1, 3, 3½, the point being, that, in order to secure the requisite strength, the walls of matrix between the particles of aggregate must be of sufficient thickness to hold firmly on all sides each piece of aggregate. To be sure of this requires an excess of mortar over the voids in the aggregate of 10 to 15 per cent. In general it is recommended that the mortar should not be less than 60 per cent. of the aggregate.

The fact that the action of traffic subjects every portion of the exposed surface of the pavement to severe treatment makes it necessary to have the requisite strength presented at all points.

Therefore, concrete for concrete roads must be more thoroughly mixed and of higher grade than is necessary in any other form of concrete construction.

Each batch of concrete as deposited in the road should be watched that the mortar does not flow to the edge of the pike and leave a core of aggregate unsupplied with sufficient mortar. At least one workman should be assigned to shovel all such cores of aggregate to the bottom of the concrete layer so as to insure only cement rich in mortar at the surface. If this is not done, depressions will develop in the surface under traffic which will loosen the clusters of pebbles of the aggregate, which do not have sufficient mortar to hold them fairly in place.



"STANDARD" LOW CHARGING *concrete mixer on street paving work, Topeka, Kas.*

The men finishing the surface should be warned not to let such places go by them without shoveling out the pebble clusters and replacing them with a richer mixture. A finisher can easily cover such a place by working a film of mortar on the surface without necessarily filling the voids below.

We have quite recently completed forty blocks of paving at Topeka, Kans., and are now working on a large contract at Wichita, Kans., in which we are using the "Standard" low charging concrete mixer, rear discharge, mounted on truck and equipped with steam engine and boiler, furnished by the Standard Scale and Supply Company, Chicago. With a gang of twelve men (two spreaders, seven wheelers, one engineer and one man each on discharge and cement pile) we have been easily averaging 900 to 1,100 square yards of 4-inch concrete per day. While the manufacturers of this machine have recently designed a more recent type of street paver, we consider our average record above the ordinary. Our machine drum has an exceedingly large opening in the charging end, thus enabling our operator to keep his eye on the batch while mixing, as it is quite important that every batch be properly mixed before discharging in order to turn out a uniform mix at all times. We credit the general uniform quality of our work to the fact that we are particular mixers. The paving contractor who does a good job at first will be assured of a steadily increasing volume of business. When one street is lined with concrete paving or walks it is only a question of time before the residents of every other street in the town clamor for the same convenience and facility. If the first job is a poor one, the property owners will kick on it, and their kicks will sound all over town and put a damper on the spirit of improvement. The true believer in concrete always wants to enjoin the builder of sorry pavements and walks, for he realizes the damage that is being done to the industry at large. There is so little difference in the cost of good work and poor work that the grafter who cheats concrete of the proper

amount of cement or the proper preparation of foundation or the thoroughness of the mix, is a pitful little piker. Municipal authorities may easily inform themselves of the approximate cost of good pavements and sidewalks, and they owe it to their towns not to accept the bid of the man who must do poor work in order to make a little profit.

Comparison of Cost of Motors and Horses Made by Milwaukee Official

"We have investigated the small motor truck, of 1,000 pounds capacity, and find that it will effect a considerable saving over horse-drawn apparatus," states a leading municipal official of Milwaukee. "In a very short time we will advertise for bids for such capacity trucks for our water and meter departments.

"We have found that the average daily estimated cost of operating a 2-ton truck is $10.83. By comparison, for a 2-horse team the average daily charges have been estimated at $8.50. A 2-ton truck has the capacity to replace two, three or four teams, while larger trucks may replace more horses, so it is a simple matter to see what the saving may be by motor trucks. And this saving is actually the difference between what it now costs for operating horses and what it costs for operating motor trucks, including all such items as interest on the investment, depreciation, insurance, stable or garage, taxes, tires, repairs, wages, gasoline, electricity, oil, light, heat and so forth.

"On investigation we find that one 1-ton Mercury truck will replace the work of three horses and two wagons and at an annual saving which easily pays for the change. The figures which we have verified are as follows for a period of five years:

COST OF HORSE EQUIPMENT.

Three horses	$ 450.00
Two wagons	150.00
Three sets harness	90.00
Feed, shoeing and veterinary, 3 horses each $20.00 per month	3,600.00
Repairs, 2 wagons, $7.50 per year each	75.00
Painting 2 wagons, $25 per year each	250.00
Repairs 3 sets harness	25.00
Two drivers, $12 per week	6,240.00
Total	$10,880.00

COST OF MERCURY TRUCKS.

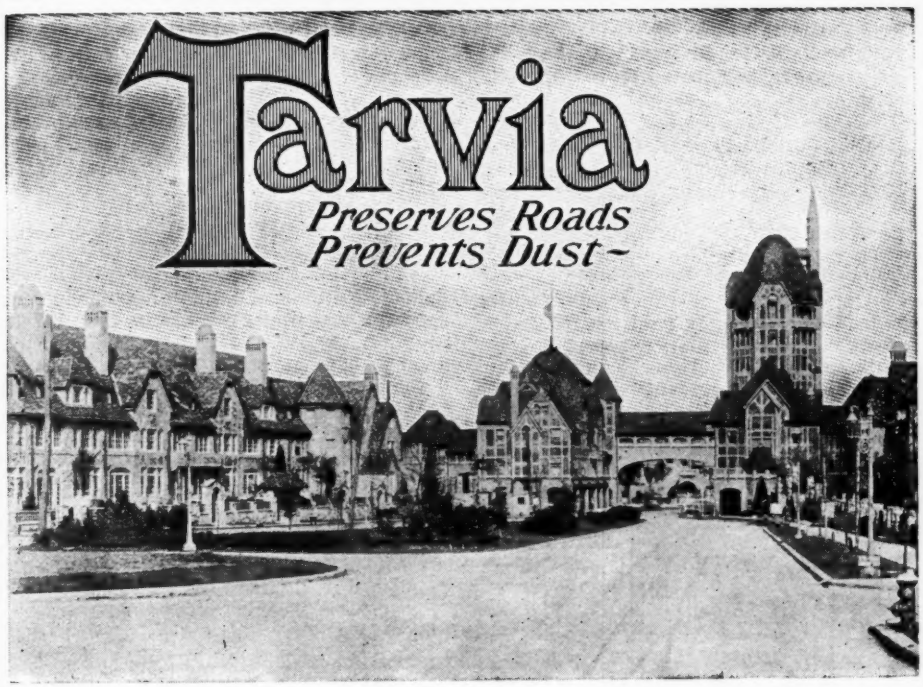
One Mercury truck	$ 800.00
Gasoline, daily average of 30 miles, 300 days per year	375.00
Barn or garage rental	600.00
Lubricating oil	300.00
Transmission grease	50.00
Recharging batteries	21.50
Repairs, $10.00 per month	600.00
Painting, $25.00 per year	125.00
Tire replacements, based on 1 cent per mile	410.00
Incidentals, cost of oil for lamps, etc.	175.00
One driver, $12.00 per week	3,120.00
Total	$ 6,576.50

Purchasing Coal by Heat Units

By Frank P. Welker, Price & Roberts, Heating and Ventilating Engineers Delaware, Ohio.

During the past two or three years the purchase of coal, or rather the payment for the same, on the basis of the heat units contained therein as shown by analysis has been adopted in general by the various departments and bureaus of the United States government, and a number of cities or city departments have also adopted the same plan. Information concerning this has recently been collected by the Clearing House of the American Society of Municipal Improvements, and we are presenting herewith an abstract of the replies received to inquiries made of more than 100 cities. So far replies have been received from 95, and 20 of these report one or more departments of the city purchasing coal in this way; these cities being Atlanta, Ga.; Moline, Ill.; New Orleans, La.; Cadillac and Grand Rapids, Mich.; Kansas City, Mo.; Omaha, Neb.; Binghamton, Buffalo, New York and Syracuse, N. Y.; Grand Forks, N. D.; Cincinnati and Cleveland, O.; Philadelphia, Pa.; Jackson, Tenn.; Norfolk, Va.; Milwaukee, Wis., and Toronto, Ont. In Atlanta, Ga., coal is purchased on the thermal unit basis by the water department only, the amount approximating 15,000 tons per year. In New Orleans about 8,000 tons per year is so purchased; in Cadillac, 500 tons; in Grand Rapids, 25,000 tons; in Buffalo, 40,000 tons; in New York, 800,000 tons; in Syracuse, 8,250 tons; in Grand Forks, 1,500 tons; in Cleveland, 30,000 tons; in Philadelphia, 117,000 tons (bituminous); in Jackson, 2,200 tons; in Norfolk, 3,000 tons; in Milwaukee, 17,000 tons; in Toronto, 20,000 tons; in Moline, 6,800 tons; in Binghamton, 2,211 tons, and in Cincinnati, 24,885 tons.

In New Orleans the system employed is only indirectly on the heat unit basis, the test being that of the actual evaporation obtained. In Kansas City, the coal for the city is obtained thru the purchasing department. During the last few years the city has been using a great deal of oil and this has lessened the importance of the method of purchasing coal. In Phila-



Sage Foundation Homes Co., Forest Hills, L. I. Constructed with "Tarvia X" 1910, Treated with "Tarvia B" 1913.

Dust is Expensive

WHEN an automobile speeds down an ordinary macadam road it leaves in its wake a cloud of dust which is carried by the winds over the neighboring fields, houses and lawns.

This is just as surely a waste of good material as if the automobilist dug material out of the highway and carted it away. Dust represents waste—costly waste—and the taxpayers feel the result. A road that is properly built for modern traffic will not be dusty.

Plain macadam gives way under the wear and tear of heavy rubber-tired automobile wheels and the surface binder of the road is torn away in the form of dust, until in time the coarse stone itself is exposed and a costly renewal of the road is necessary.

Modern roads should be built to resist modern traffic. To build any other kind is wasteful. A better binder than the ordinary mineral binder is needed and is offered in Tarvia, a coal tar compound especially prepared for use on roads.

Tarvia is dense, viscid, waterproof. It fills the interstices between the stone and forms a tough, plastic matrix. This makes a waterproof and automobile-proof surface. The maintenance cost is usually so low as to more than balance the cost of Tarvia treatment.

Booklets on Request.

BARRETT MANUFACTURING COMPANY

TRADE B MARK

New York Chicago Philadelphia Boston St. Louis Kansas City Cleveland
Cincinnati Minneapolis Pittsburgh Seattle Birmingham
The Paterson Mfg. Co., Ltd.—Montreal Toronto, Winnipeg, Vancouver, St. John, Halifax, Sydney, N. S.

delphia anthracite coal is not purchased in this way, altho bituminous is. Jackson reports that its coal is "not entirely" purchased on this basis. In Norfolk coal is purchased in this way "in some cases."

Inquiry was made as to the saving which is probably effected by this system, to which question the following replies were made:

Cadillac, Mich.—Twenty-five per cent.

Grand Rapids, Mich.—About 10 per cent.

New York City—Many thousands of dollars.

Syracuse, N. Y.—"I do not look for any saving in the total of money expended for coal by this method. We hope and expect to bring the coal purchased up to the standard of the money paid for it."

Omaha, Neb.—About 10 per cent.

Philadelphia—"There is a saving, but impossible to state amount."

The more important parts of the several specifications are given below:

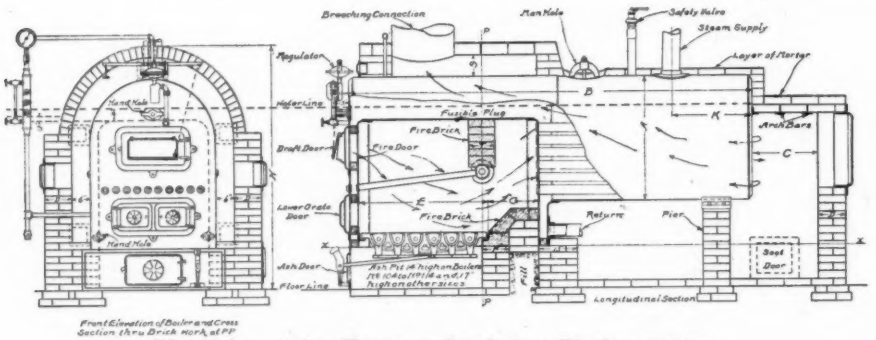
Atlanta—A sample of the coal to be furnished will be analyzed by the water department and the B.t.u., per cent. of volatile matter, ash, sulphur, etc., will be ascertained; and any coal furnished under the contract which does not come up to the test of the sample on which the contract was awarded may be rejected, or deductions in the price may be made as follows: For each 100 thermal units or fraction thereof less than that shown in the sample, the price is diminished 1½ cents, and 1 cent for each one-half of 1 per cent. of ash in excess of the sample.

In Moline, Ill., the standard is not less than 12,000 B.t.u.; not over 10 per cent. ash; not less than 40 per cent. volatile matter; not less than 50 per cent. fixed carbon; not over 5 per cent. sulphur.

In Cadillac the board of education fixes the standard of coal which it will accept as follows: Fixed carbon, over 71 per cent.; volatile hydro-carbons, less than 22 per cent.; moisture, less than 2 per cent.; ash, less than 6 per cent.; sulphur, less than 0.75 per cent. Any coal not coming within 10 per cent. of the above limits may be rejected.

The specifications at Grand Rapids require that heat value per pound of dry coal be stated by the bidder, and if calorimeter tests show the coal to fall below this standard a rebate is made from the contract price, and an increase being made in exact proportion to the B.t.u. For instance, if the bidder guarantees 15,000 B.t.u. per pound and the coal be found to contain 14,000, the contractor would receive 14-15 of the contract price. Any coal which shows more than 5 per cent. less heat units than the fixed standard may be rejected. Standards are established for different kinds of coal, varying between the limits of 15,000 and 11,000 B.t.u., a minimum of 44 to 71 per cent. fixed carbon, a maximum of 15 per cent. to 6 per cent. ash, and a maximum of 3 per cent. to ¾ per cent. sulphur.

In Binghamton, N. Y., it is specified:



PLAN *for setting Kewanee Smokeless Firebox Boiler.*

"No bituminous coal which shows on analysis less than 93 per cent. combustible matter, more than 6 per cent. of ash, or more than 1 per cent. of sulphur, will be accepted. The bidder must submit an analysis of the coal that is bid on, which analysis must show a heating value expressed in terms of B.t.u. per pound of coal. All coal that may in any respect fail to conform to the specifications and analysis submitted with the bid will be rejected.

In New York City the standards for B.t.u. vary from 13,200 per pound of dry coal for broken coal to 12,000 for buckwheat No. 3; and the ash, from 11 per cent. in broken coal to 19 per cent. in buckwheat No. 3. Eight per cent. volatile combustible matter and 1.5 per cent. of volatile sulphur are the maximum amounts allowed. The maximum of moisture is set at 4 per cent. for broken coal up to 6 per cent. for buckwheat No. 3. If the moisture is in excess of the limit, the gross weight of the coal is corrected by an amount directly in propor-

Cubanel
TRADE MARK

CUBAN NATURAL ASPHALT

is being used more and more extensively by leading city engineers, paving contractors and street commissioners as well as by park superintendents and engineers in all parts of the country.

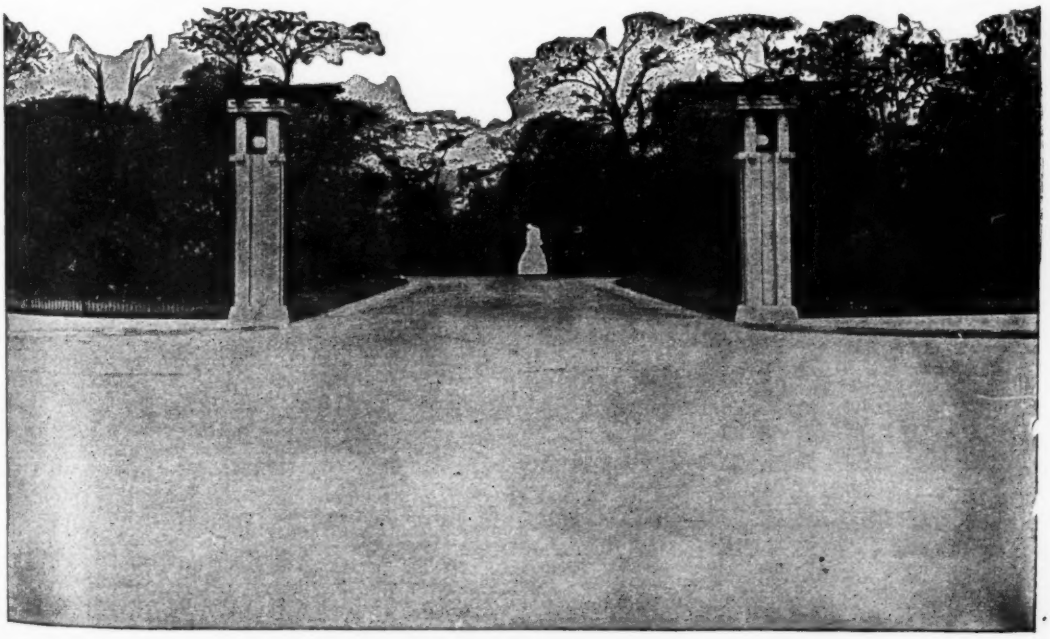
BECAUSE

CUBAN NATURAL ASPHALT CONCRETE insures the most efficient, durable, economical and practically sound-proof pavement with a malleable wearing surface not affected by varying temperature and which is at once waterproof. Its finish gives granular surface which insures good footing, will not pulverize into dust nor will show no movement during summer months or become brittle during the cold months.

Send us specifications covering your requirements and we will gladly send you prices on Cubanel macadam road binder, sheet asphalt, brick or granite filler.

International Asphalt Company,

Chamber of Commerce Bldg. **CHICAGO.**



Cubanel Entrance to Humboldt Park, West Chicago Park District, Chicago.

tion to such excess percentage of moisture; that is, if there is 2 per cent. excess in moisture the gross weight of the coal is reduced by 2 per cent. After this deduction has been made, the weight is further reduced at the rate of 1 per cent. for each per cent. of ash in excess of the standard. The gross weight after correction for excess moisture is further reduced at the rate of 1 per cent. for each 100 B.t.u. below the standard; 5 per cent. for each 1 per cent. of volatile sulphur in excess of the standard; 2 per cent. for each 1 per cent. of volatile combustible matter in excess of the standard. Payment for the coal is made on the basis of the gross weight, less deductions made as described.

In Grand Forks the standard is 12,000 B.t.u. and less than 15 per cent. ash. "The price paid for the coal shall be based on the 'net B.t.u. per one per cent' received, as found by accurate calorimetric analysis. This 'net B.t.u. per cent.' shall be determined by multiplying 'B.t.u. with moisture' as delivered by 2,000 and dividing this product (B.t.u. per ton) by the price of the coal delivered in cents per ton plus 60 times the percentage of ash. The cost of removal of ash is estimated at 60 cents per ton. The price of the coal as quoted, divided by the ratio of the 'B.t.u. per one cent' guaranteed to the 'B.t.u. per one cent' actually found by test, shall be the price paid. A 2-per cent. variation either way in ash will be allowed without change in price."

Obviously the first step toward the most economical heat or power production is in the purchase of the fuel that contains the elements of heat, carbon either fixed or in volatile gases, hydro-carbonaceous gases, the proper amount of moisture and a very small amount of ash, sulphur and other non-heat-producing materials.

Following the selection of the best coal, but just as important, is the selection of a boiler or furnace which will utilize the maximum number of heat units which the fuel contains.

The principal fault with the majority of boilers or furnaces (where they are faulty) is due to a construction which allows the heat producing gases to come in contact with the comparatively cool surface of the boiler before they can be burned. This chills these gases, turns them into smoke and renders them of no value, as smoke once made cannot be unmade.

This truth then can be stated—"eliminate smoke and the coal bill is reduced."

There are on the market today smoke prevention devices. Mind you, I do not say smoke consuming devices, for smoke cannot be burned, the only remedy being to burn all the gases before they become smoke. These devices consist of various mechanical stokers, fire brick arches so arranged as to give longer travel to the hot gases before coming in contact with the cool boiler surface, and during the past few years several makes of firebox boilers, which as a type have proven very successful.

Particularly for heating purposes the firebox boiler, set in brick, has proved itself to be probably the most satisfactory and economical on the market. And the smokeless firebox boiler is the same with the Hawley down-draft furnace, well known to all heating engineers.

The Kewanee Boiler Company, Kewanee, Ill., is the manufacturer of what is commercially known as "The Kewanee Smokeless Firebox Boiler," same being a type of hand-fired, smokeless heating boiler, which is especially deserving of attention. The principle is the one described, a firebox boiler, brick set, and of a Hawley down-draft construction. This boiler is equipped with two sets of grates, upper and lower, the upper grates being water grates. The fresh fuel is fed into the upper grates and the fire on the lower grates is merely that which is maintained by the hot coals which drop down from above. The draft of this boiler is down, the flames and volatile gases passing first thru the fire, the bed of hot coals from the upper grates, then on down and over the hot coals on the lower grates. As fresh air is drawn into and over the lower grate, from the lower draft door, these gases find a fresh supply of hot air awaiting them, which makes it possible to consume all of the gases in the coal.

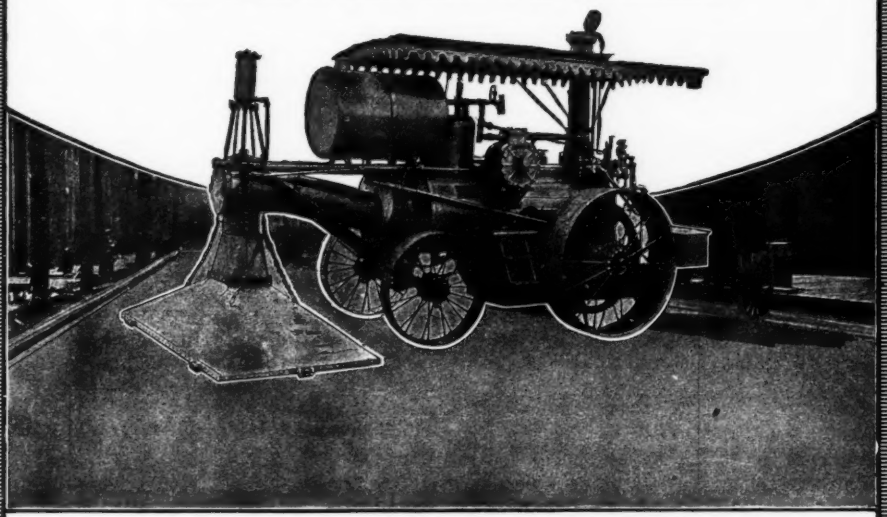
Mechanical Trench Tamping

By W. F. Darling, Superintendent of Streets, Riverside, Cal.

It is my opinion that the time is not far distant when municipalities will require that all back-filling of trenches be mechanically tamped. There is a popular notion that trenches should be allowed to settle for a year before paving and that then they are safe. This is not only a fallacy, which breeds carelessness in cases where it is thought no pavement will be laid in a year or more after all mains and house connections are made and equally impracticable to avoid cutting into pavement for installation of and repairs to service pipes. We all know that by careless or indifferent filling of trenches unpaved streets are often rendered dangerous and nearly impassable for years.

In one instance no trouble developed in the construction of an asphalt pavement laid on concrete foundation, but three years later a horse's hoof broke thru the

Leading Cities are using THE LUTZ SURFACE HEATER in repairing and re-surfacing their old asphalt, brick and stone pavements.



Repairs can be made at a saving of 40 to 50 per cent over the cost of repairing by the old method of chopping up the old pavement and hauling it to the dump.

The Lutz Surface Heater

—gently heats and softens (without flame) old pavements to same consistency as new material. The temperature of both materials being at vulcanizing point, when tamped, smoothed and rolled a perfect weld is produced, leaving a finished surface. Instead of having a "patch" the repair becomes a part of the whole.

Equitable Asphalt Maintenance Co.

Commerce Building. **Kansas City, Mo.**

Illustrated particulars on request.

Nearly all cities have condemned the use of all machines forcing the flame upon the pavement because of the destructive effect of intense heat, and the **Lutz** *method should not be confounded with these destructive appliances. The result of the work done through this principle has been highly satisfactory in every city where it has been used.*

M-E

surface of the pavement and he broke his leg. Examination revealed a hole six feet deep, which it took fifty loads of earth to fill, over a sewer trench ten years old. It is very common for a pavement to settle a year or more after laying it over a sewer trench, filled several years before the pavement, where no trouble developed during the rolling and laying of the pavement. It is still more common to find almost insurmountable difficulty, while the paving is in progress, from settlement of old trenches. So much for the theory that however carelessly a trench or other fill is made it will settle itself within a year. On the other hand, I have never known of a case where trouble has followed from the settlement of sewer or

STALEY TAMPER, *Riverside, Cal.*

service pipe trenches made immediately before the laying of the pavement where I had supervision of the backfilling, even with treacherous soil conditions.

I would far rather guarantee a pavement laid immediately after a sewer trench, the filling of which I could control and mechanically tamp, than five years after the laying of a sewer, the trench of which was filled with the generally customary carelessness and usual view only to least possible cost.

There is no work connected with public improvements that has a more important bearing on the durability of pavements than the backfilling of trenches, and it is surprising how few engineers understand the proper way of refilling a trench. There are, of course, many soils to cope with, but each must be treated on the same general principle, i. e., to fill all the voids, that in every case all the particles may be as close together and as tightly compacted as possible, and it is my opinion that this result can only be accomplished by mechanical tamping.

We have been operating a Staley power tamper with considerable success, furnished us by the Lourie Mfg. Co., Springfield, Ill. This machine was purchased in November, 1910, and has been in operation almost continually since that date. It has been used principally for tamping back-fill of gas, water and sewer trenches. It easily does the work of eight men and tamps much more compactly than can be done by any hand machine, particularly on improved streets where the dirt has been compacted by heavy rolling. This mechanical tamper does very excellent work in the winter time. We have never had any settlements in trenches tamped by means of this machine nor have the materials to be tamped any effect on the efficiency of the work done.

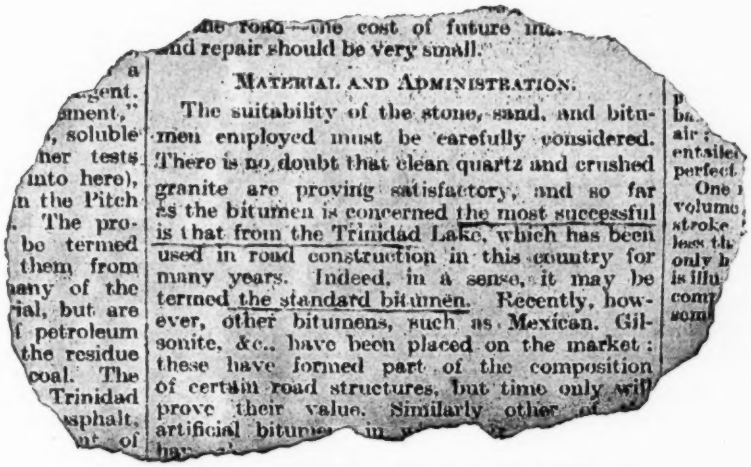
The Staley tamper, in our opinion, not only reduces labor cost of tamping, but is a machine deserving the investigation of every city engineer and street commissioner.

A Portable Loading Machine

A portable loading and screening equipment, designed for reclaiming stone from spent macadam roads, has been satisfactorily and economically used by the Cranford Company, of Brooklyn, for whom it was manufactured by the Link-Belt Company. The machine consists of a bucket elevator, a rotary screen and two chutes, operated by chain and sprocket driven by a 9-h.p. gasoline engine, and the whole mounted on a steel frame work of angle sections supported by four iron wheels. A tongue attached to the axle of the small front wheels allows the machine to be moved by hand or as a trailer to a wagon. A belt-conveyor trailer forms part of the equipment when used on work requiring the machine to be frequently moved. This trailer is a two-wheeled affair with a wagon-like body, the bottom of the body being an endless belt somewhat cupped.

In repaving work the old macadam is first thoroly loosened by plowing. Ten or twelve men with shovels then deposit the old road material in the belt-conveyor trailer attached to the foot of the elevator, which in turn feeds the dirt and stone to the rotary screen at the head. Under the screen are the two chutes, one collecting the dirt and fine material which

Trinidad Liquid Asphalt **Bermudez Road Asphalt** **Trinidad Lake Asphalt**



...de road—the cost of future ma... ...and repair should be very small."

MATERIAL AND ADMINISTRATION.

The suitability of the stone, sand, and bitumen employed must be carefully considered. There is no doubt that clean quartz and crushed granite are proving satisfactory, and so far as the bitumen is concerned the most successful is that from the Trinidad Lake, which has been used in road construction in this country for many years. Indeed, in a sense, it may be termed the standard bitumen. Recently, however, other bitumens, such as Mexican, Gilsonite, &c., have been placed on the market: these have formed part of the composition of certain road structures, but time only will prove their value. Similarly other ... artificial bitumen... in ...

...a ...gent. ...ament," ..., soluble ...her tests ...into here), ...n the Pitch ... The pro- ...be termed ...them from ...any of the ...ial, but are ...f petroleum ...the residue ...coal. The ...Trinidad ...sphalt, ...nt of

...p... ...ba... ...air; ...entailed ...perfect. ...One ... ...volume ...stroke ... ...less th... ...only h... ...is illu... ...comp... ...som...

From Engineering Supplement, London Times.

Trinidad Lake Asphalt

has been used for the construction of something like 170,000,000 square yards of city pavements.

The oldest smooth pavements now in existence after more than a quarter of a century of service are Trinidad pavements.

The pavements showing the lowest maintenance costs for the longest period of life are Trinidad pavements.

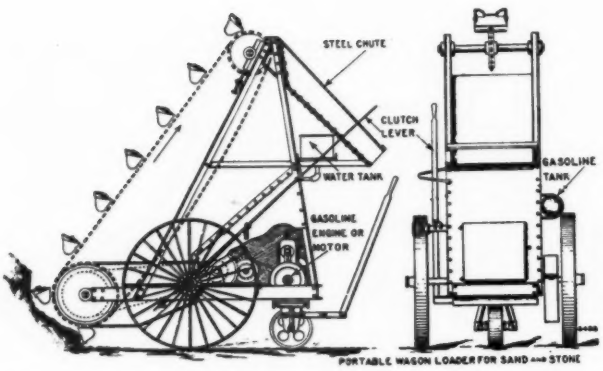
It is not likely that the world's most progressive communities would continue to use Trinidad Lake Sheet Asphalt to an ever-increasing extent if any better type of pavement had been devised, or if any better material was available.

And not only is Trinidad Sheet Asphalt the world's highest paving standard—it is among the lowest in first cost and the most economical in the long run.

Engineers, contractors and taxpayers may well consider these facts in connection with plans for new paving.

The Barber Asphalt Paving Co.

PHILADELPHIA, PENN.



SECTION *of link-belt portable excavator and loading machine.*

is screened out and delivered to carts drawn up along one side of the loader. The other chute collects the clean stone coming off the end of the screen and passes it out the other side of the loader. This stone may again be used for concrete purposes.

One advantage in the use of the loader is that the men shoveling the loosened macadam into the trailer do not have so high a lift as if they were loading it directly into the dump carts. The machine is so arranged that the belt-conveyor trailer at the foot and the rotary screen and the chutes at the head can be taken off the portable elevator frame and a direct chute placed under the head of the elevator, so that the machine can be used for loading concrete materials, such as crushed stone and sand, from storage piles to carts.

The contracting company finds that with three men on the stone pile and a fourth to operate the clutch and control the loading, 2-inch stone can be handled from the ground storage pile to auto trucks at the rate of about 35 tons an hour. This is a saving of about 60 per cent. over the hand-shoveling method, as well as an economy in the time of the truck. The men on the pile use rakes to agitate the stone and keep it flowing to the foot of the elevator, where the buckets pick it up and discharge it to the carts thru the direct chute.

This machine is a development of the Link Belt portable wagon loader, a device which is built by the Link-Belt Company, of Philadelphia, for handling coal, sand, etc., where capacities up to 70 tons an hour could readily be maintained.

Portable wagon loaders of this general type are also rapidly coming into prominence for handling sand and gravel. Because of the fact that this material flows more readily than stone, large capacities can be obtained without increasing the size of the machine.

"This loader easily handles 60 tons per hour," states a leading contractor. "Under actual test we loaded five-ton wagons in five minutes' time and found as an average with the backing up and getting under the loader, that a wagon can be loaded in about six minutes. It usually took us about thirty minutes to do this work with three men.

"We are now using the loader daily and by the use of same have been able to cut down the force in our yard by two men, as these men were only used to load teams with coal we had on the ground.

"You can see from this that the machine is not only a saving to us but also a saving to the companies who are doing the carting, as their wagons are not held up over five or ten minutes in our yards where they were formerly held from one-half to three-quarters of an hour? It is needless to say that we are very much pleased with the machine.

"We are troubled no more with our yard becoming congested with wagons, and the amount that each team can handle a day is increased about 10 per cent. Our statements from the electric company show the cost of power to amount to about one-third of a cent per ton handled.

"We use one man to operate loader and help coal to foot of machine, and the labor of screening is entirely eliminated, as the coal is automatically screened while it is loaded and the breakage of coal around the machine is very little. This fact and the very short time required to load each ton means that the same yard can handle two or three times as much coal, or, looking at it the other way, the yard force can be reduced by about one-half for the same amount of output."

Advantage of Motor Combinations

By Thomas E. Heath, Chief Fire Department, Saskatoon, Sask., Canada.

The two first pieces of motor apparatus installed in this department were two Seagrave combination hose wagons and chemical engines, the six-cylinder, 80-h.p. combination being placed in service September, 1911, and the four-cylinder, 50-h.p. combination being placed in service in February, 1912. We do practically all of our work with these two machines, holding our horse-drawn apparatus in reserve.

The auto combination will make better

Ceresit

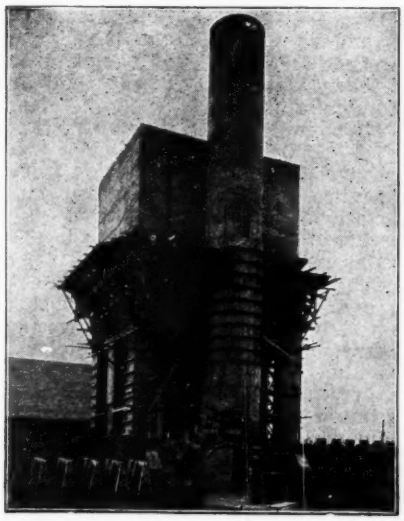
Concrete Ceresitized is Concrete Waterproofed at THE LOWEST COST.

Ceresit is a Cream White Paste which is placed in the water used in mixing the concrete—the water holds the Ceresit in suspension and carries it uniformly throughout the concrete in the mixing process, thus thoroughly waterproofing the entire concrete mass.

Ceresit is specified and used by leading engineers and contractors all over the world for the waterproofing of tunnels, dams, reservoirs, foundations, swimming pools, bridges, water towers, sewers, conduits, viaducts, aqueducts, filtration and septic tanks, drinking fountains, boiler pits, intakes, etc.

There is nothing in Ceresit advertising that is not in Ceresit.

Ceresit
is an *absolute* and *unfailing water repellant* which protects the concrete from disintegration and damage from frosts.



Ceresitized Water Tower,
Huntington, N. J.

Ceresit
makes concrete more dense without altering its color or lessening its tensile strength —*requires no scientific mixing machines* and is nominal in cost.

Ceresit Waterproofing Co. 62 W. Adams St. **Chicago.**

Branches { 1133 Broadway, New York.
1218 Chestnut St., Philadelphia.

Ceresit factories are located in Chicago; Unna, Westphalia, Germany; London; Paris; Vienna; St. Petersburg.

or quicker responses than the horse-drawn in all kinds of conditions of streets or weather. This has been proven many times in all parts of the country. In my city the automobiles were in use and making good runs last winter in from ten to fifteen inches of snow.

As fires are destructive in proportion to the time taken in getting at them, providing the same intelligence is employed in each case, the importance of attacking a fire before it has developed into a bad one is fully recognized by all firemen and also by the insurance interests. It is a well-known fact that the latter require the installation of fire extinguishing apparatus in factories and in other dangerous places, so that fires may be extinguished before a large blaze has developed.

Prompt action is required in the fire service and the auto is and is to be the means of that prompt action.

In most cities using chemical engines or combination chemical and hose wagons, reports state that at least 75 per cent. of the fires are extinguished by chemicals alone. In all probability the general use of the auto comibnation will increase this percentage to 85 or 90 per cent., owing to the speed in arriving at the fire and consequently the more general use of the chemical tank attached.

The auto combination will be a great success in handling brush and grass fires, getting on the job so much quicker than horse-drawn apparatus that the fire is still of no great extent, and so will be handled in much shorter time and apparatus and men returned to station ready for the next run, the auto apparatus making quick returns as well as quick responses.

Looked at from the economical side, there will be a great saving in space occupied, so that new stations may be much smaller, lots purchased may be much smaller, and the total expense will also be correspondingly reduced. Cost of heating and lighting and water bills will be reduced. There will be a saving of one man, as the driver will have no horses to watch and can be used as a fireman in fighting the fire.

We can cover a much larger territory; so, altho we must have enough apparatus and equipment for the very large fires, I think the time will come when more apparatus will be kept as a reserve and possibly a reserve force of men to be called only in time of a very large fire. This would reduce the necessary regular force to quite an extent; especially will this apply to cities up to 75,000 populttion. Cities of over 75,000 may not be able to depend on such a reserve force.

In using horse-drawn apparatus, if a horse falls and breaks a leg, the horse must be shot; but with the automobile, repairs are made and the apparatus is as good as ever; and it is my belief that there will be less failures to arrive in response to alarms with the auto apparatus than with the horse-drawn apparatus.

There are no horses to feed when the machine is not in use and the expense is practically nothing when not actually in service.

The life of auto apparatus has not yet been determined, but it is probable that with good care it will last fully as long as the horse-drawn apparatus.

We have exceedingly bad roads during both spring and fall seasons, but have never stalled our motor-driven combinations. Our winter weather ranges from zero to 50 degrees below, but we have never experienced any engine troubles.

During the past year our apparatus responded to 185 alarms, using 35,750 feet of hose, 901 feet of ladders and 1,553 gallons of chemicals. Time of service in answering these alarms, 116 hours and 37 minutes; distance traveled to and from alarms, 470 miles, 395 yards.

The strength of the department at the present time is composed of the following: One chief engineer, one assistant chief, one engineer of steamer and master mechanic, three captains, three lieutenants, one lineman, thirty privates and one stenographer.

Our 80-h.p. Seagrave motor combination carries 1,000 feet of 2½-inch hose, one 45-gallon chemical cylinder, 150 feet of chemical hose, a full equipment of nozzles and all the other tools required in the service, two short extension ladders. We have one city service hook and ladder truck, carrying from a 60-foot extension ladder down to 12-foot ladders.

The first consideration in getting motor apparatus is to get the necessary strength in all parts in proportion to the strength in horsepower. For instance, if you should purchase a 90-h.p. machine, you should see that the transmission, differential, frame and all parts are built sufficiently strong to withstand the shock to which a 90-h.p. motor would subject them. If this precaution is not followed results may follow such as are experienced when we hitch a team of draft horses to a light vehicle and get stuck in the mud. The team is too strong for the vehicle, and you will soon hear something break.

I expect this fall to install a motor city service truck and also a pumping engine. This pump will be purchased after the convention at New York. We want the best, therefore will inspect the pumping engines at New York and place order for the pump that makes the best showing.

SARCo
THIS SHIPPING PACKAGE
SAVES YOU MONEY
By its use we deliver asphalt with a tare of only 2%.
That means approximately 1,960 net pounds of asphalt to each gross ton shipped.
The drum is easily removed and the asphalt does not stick. Hence —no waste.
Write for proofs of how this package puts money in your pocket.
Standard Asphalt & Rubber Co.,
137 SO. LA SALLE ST.
CHICAGO.

Resurfacing Bituminous Pavements

By Capt. Brook, U. S. A., Assistant Engineer Commissioner, Washington, D. C.

The sum of $425,000 was appropriated for 1912 for resurfacing of old pavements and repairs to improved roadway pavements. This was an increase of $25,000 over the appropriation for the preceding year. The area of sheet asphalt pavements in the District of Columbia is about 3,343,978 square yards, and of asphalt block 648,368 square yards, which is probably a greater area than any other city in the world with the population of the District of Columbia.

During 1912 183,770 square yards of old pavement were replaced, as compared with 183,000 square yards replaced during the preceding fiscal year.

It is believed that the great area of asphalt pavement can be most economically maintained if the average age be retained at about eleven years. This would mean a resurfacing of about one-twenty-second of the entire area in sheet asphalt surface annually. An appropriation of $330,000 for resurfacing and repairs will, it is calculated, after other pavements are maintained, permit the resurfacing of an amount annually that will retain at its present average life the entire amount of street surface that is now in sheet asphalt. Inasmuch as the average age of all sheet asphalt pavements is still in excess of 11 years, an amount is asked for the fiscal year 1914 in excess of $330,000; that is to say, $390,000.

A statement of the resurfacing of pavements in the District of Columbia, by means of the Lutz surface method, for the year 1912 follows:

Street and Character.	Year laid.	Square yards.	Cost.
A street—Asphalt	1880	2,308	$1,989.93
Corcoran street—Coal tar	1877	2,031	1,413.07
E street—Asphalt	1879	5,186	3,896.64
I street—Asphalt	1886	806	617.76
Massachusetts avenue—Coal tar	1873	3,333	2,708.64
New Jersey avenue—Asphalt	1877	1,557	1,552.42
R street—Coal tar	1889	4,753	3,785.76
First street—Asphalt	1895	1,198	696.96
First street—Asphalt	1893		
First street—Asphalt	1895	6,925	5,346.67
First street—Asphalt	1893		
First street—Asphalt	1895	185	142.56
Third street—Asphalt, bituminous base	1890	4,028	3,101.57
Third street—Scratt coal tar	1875	4,552	3,749.38
Fourth street—Asphalt block	1891	888	681.12
Fifth street—Asphalt	1879	2,058	1,409.76
Sixth street—Asphalt	1880	1,844	1,267.20
Twenty-second street—Asphalt	1895	2,204	1,666.51
Twenty-fifth street—Asphalt, bituminous base	1890	1,625	1,219.68
Thirty-third street—Asphalt	1883	1,090	887.52
Thirty-fifth street—Asphalt, bituminous base	1890	6,068	4,260.96
Totals		52,639	$40,394.11

The prices for resurfacing and repairing asphalt pavements under contract during the year 1913 are as follows:

Laying sheet asphalt pavement (2½ inches asphalt surface, 2-inch binder, before compression), with 6-inch concrete base, per sq. yd.	$1.68
Laying sheet asphalt surface (2½ inches before compression), per sq. yd.	.64
Laying sheet asphalt surface (resurfacing by heater method), per cu. ft.	.66
Laying asphalt binder (in connection with resurfacing work, per cu. ft.	.38
Laying sheet asphalt surface (for repairs and miscellaneous work, cuts, etc.), per cu. ft.	.57
Laying asphalt binder (for repairs and miscellaneous work, cuts, etc.), per cu. ft.	.43
Laying sheet asphalt surface for repairs, etc., within the space required by law to be kept in repair by street railway companies, per cu. ft.	.63
Laying asphalt binder for repairs, etc., within the space required by law to be kept in repair by street railway companies, per cu. ft.	.48

The types of roadway pavements laid during 1912 were the same as in past years—sheet asphalt and asphalt block, with a limited amount of asphaltic macadam. About $150,000 was spent on this last named class of work.

The repair of sheet asphalt pavements by use of the Lutz heater method was continued, about 53,000 square yards being thus repaired during the year. These machines were furnished by the Equitable

BOSTON

The Pioneer in Creosoted Yellow Pine Block Paving.

Unbiased statements of Engineers who superintend the construction of streets are dependable and absolute authority from every standpoint.

Tremont Street, near Temple, Boston, Mass. Laid in 1900—Southern Long Leaf Yellow Pine.
This street is heavily traveled and in excellent condition today, having cost practically nothing for repairs.

"I consider a treated **Long Leaf Yellow Pine** block suitable for any traffic; blocks that have been under wear for thirteen years are apparently as serviceable as ever — the maintenance of our wood block paving has not cost the contractors or the city anything during the past twelve years, nor do we look for any outlay in the immediate future, judging from present conditions.

"The streets that receive the heaviest traffic in Boston are paved with Southern Yellow Pine Creosoted Blocks, also some of the finest resident sections. The pavement is highly satisfactory and economical in each location in every sense of the word for both heavy and light traffic streets."

MR. JAS. H. SULLIVAN, Division Engineer,
Board of Public Works, City of Boston.

MR. ENGINEER: Yellow Pine Creosoted Blocks give the property owner and city official better paving value for money expended than any other kind of paving material. **Use It**—The city must pay for all repairs. The absence of "necessary repairs" with Creosoted Yellow Pine wood blocks makes it possible to construct *new pavements*—a much better record than a constant financial drain for semi-annual repairs (and then some) on less durable pavements.

Write for literature and information

Yellow Pine Manufacturers' Association

711 Wright Building
ST. LOUIS, MO.

Asphalt and Maintenance Company, Kansas City, Mo.

The Lutz method consists in drawing a large volume of air, heated to the proper temperature, from a heating chamber and blowing it with great force upon the asphalt or other bituminous pavement, thereby gently heating and softening without flame the old pavement to the same consistency as the new material. Then with the use of hoe and rake all disintegrated materials, uneven or worn surfaces are removed and joints cut, and while the pavement is still hot sufficient new material to bring up the grade and contour of the street is added. The temperature of both materials being at the vulcanizing point, when tamped, smoothed and rolled a perfect weld is produced, leaving a finished surface. Instead of having a patch, the repair becomes a part of the whole.

Bitulithic for New York State Highways

The New York State Legislature inserted in the state highway laws this year a provision that "in the construction, maintenance or repair of state or county highways, no patented material or article or any other material or article shall be specified contracted for or purchased, except under such circumstances that there can be fair and reasonable opportunity for competition, the conditions to secure which shall be prescribed by the commissioner of highways."

On July 22, 1913, State Highway Commissioner John N. Carlisle, adopted rules of competition for bitulithic patented pavement, providing that upon the owners of bitulithic pavement patented by Warren Brothers Company, of Boston, Mass., complying with the following requirements, the use of their pavement is permitted in the State of New York until further order of the commission.

Upon the commissioner of highways determining that any pavement in any city or village on any county or state highway in the State of New York shall be constructed of bitulithic pavement, the owners of said patent, within five days thereafter, shall file with the state highway department at their office in the city of Albany, N. Y., a price at which they will deliver said material to contractors in connection with said work to be constructed or improved. Said price to be available for any contractor desiring to bid upon said work and the provisions of the offer of said company to be approved by the State Department of Highways."

The villages of Lowville, Oriskany Falls and Ilion and the cities of Johnstown, Rome and Whitesboro have petitioned for the laying of bitulithic on state highways running thru these municipalities under Section 137 of the New York State Highway Laws.

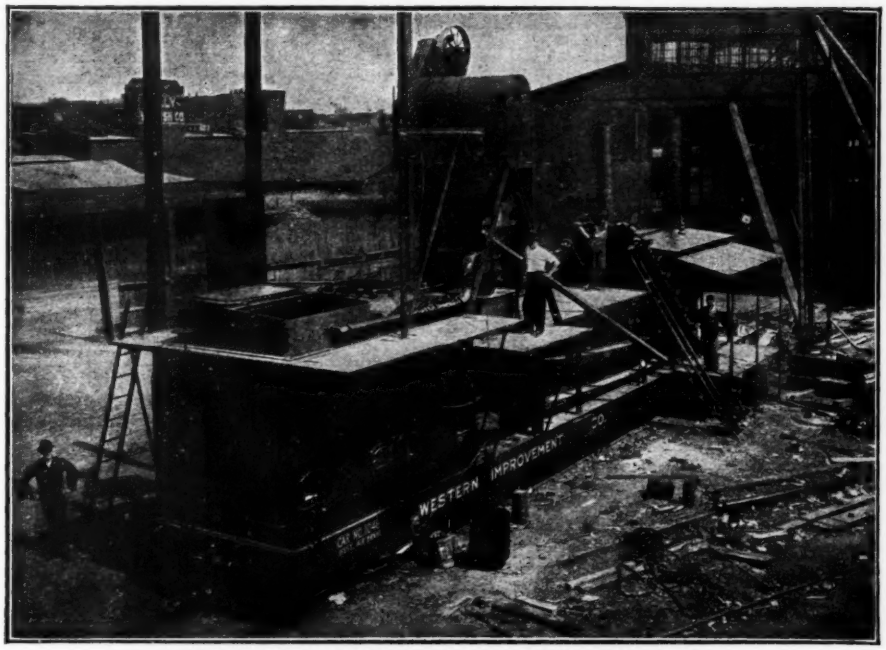
Economy of Traction Hauling on Gatchellville Road, York County, Pa.

By John F. Hammond, General Engineer.

In building this road nearly 14,000 tons of 2-inch stone were required, and owing to the inaccessibility of the location and the prohibitive grades from other nearer depots, all the stone had to be hauled from York, at nearly the southern end of the route; and because of these grades, team hauling was exceedingly expensive and slow, as a team of average weight usually found among the farmers could not move over two tons per day for a wage of $3.50, or $1.75 a ton. The grades of the finished road were approximately 7 per cent. on some of the hills for a considerable distance. The records on which this article is based were started on August 1, 1912, after two miles, one-half of the road, had been built, and continued up to November 14, 1912, when the road was completed. These records were kept as a means of information and to promote efficiency by compelling daily report of the materials used, wages paid and work done.

We pumped directly from a barrel sunken in the bed of a brook into a large tank placed on the roadside, high enough to fill the engine tanks by gravity, but made the mistake of not having our outlet from the large tank of sufficient size to fill our engine tanks as quickly as we might have done, and delays occurred at the tank that were needless and annoying. Water was pumped into the supply tank by a small 1-cylinder gasoline pump, which operated very cheaply, and only required the services of the engine driver to start and stop it as he passed on his trips. The wages paid to the engine crew were: Engineer, $3.50 per day; fireman, $1.75 per day, steady time for ten hours daily; overtime at same hourly rate. The fireman operated the stone-spreading cars, making the spread of even thickness, which requires considerable experience and should be closely watched by the overseer, as the tendency is to spread too deeply and superfluous stone would have to be removed at an extra expense. Supervision in our case was figured at one-third of the superintendent's time, or $2.28 per day with no extra time allowance. Interest and depreciation are figured on the new value of the machinery and on an estimated

MODEL OF 1912 ONE-CAR PLANT.



1,000 SQUARE YARDS 2-INCH TOPPING PER DAY.

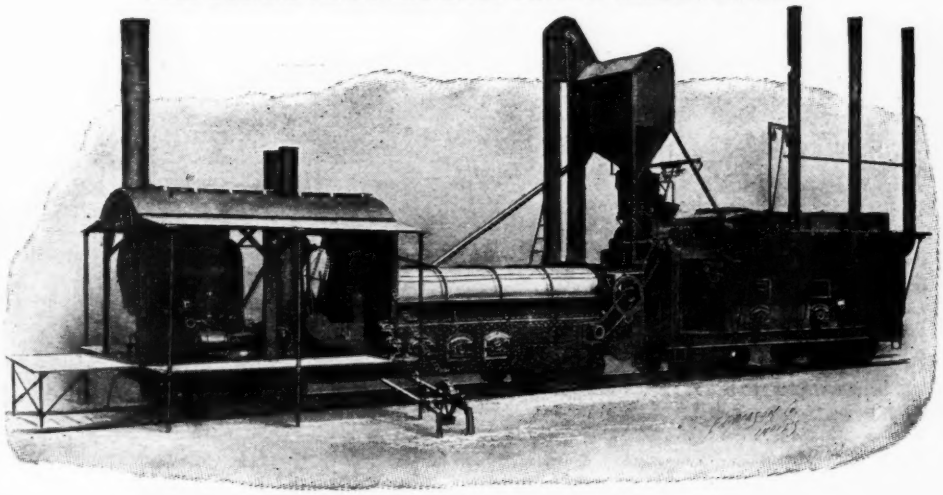
HETHERINGTON RAILWAY ASPHALT PAVING PLANTS

The product of 16 years experience in Plant Building by the originators of the first railway plant. **Still lead, are only safe railway plants made.**

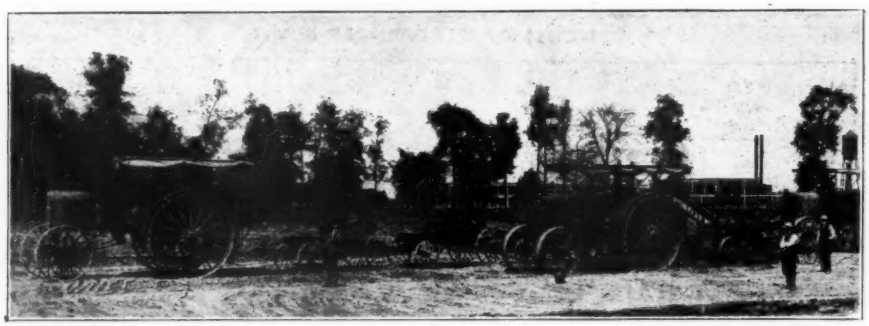
THESE PLANTS HAVE NO EQUALS. WRITE FOR CIRCULARS.

HETHERINGTON & BERNER, - INDIANAPOLIS. IND.

1,500 SQUARE YARDS AND 2,000 SQUARE YARDS PER DAY.



MODEL OF 1912 TWO-CAR PLANT.



HUBER TRACTOR *hauling stone for road construction.*

life of four years, or 25 per cent. depreciation per year, with an interest charge on the capital invested of 5 per cent. The sum of the interest and depreciation, however, are figured for the whole year and divided into the days that we actually worked. This is hardly fair to the machine, as it might have done more days' work and thus reduced this item.

The following tabulations show our conclusions and we think may be considered quite accurate. I have not thought it necessary to make an analysis of the repair account, which consisted of castings, bolts, nuts, valves, pipe elbows, engineer's and fireman's time and many small items.

Total Cost of Operation—93 days.

Operating	$ 945.67
Repairs	310.17
Depreciation and interest	686.15
Supervision	239.40
Total	$ 2,181.39

Analysis of Operating Account.

4.70 tons coal at $4.50	$ 21.15
3.49 tons coal at $5.00	17.45
913.4 tons coal at $3.26	297.77
Water	66.27
67 gal, cylinder oil at 30 cents	20.10
30½ gals. black oil, at 9½ cents.	2.94
333½ pounds grease at 5½ cents	18.77
71 lbs. waste at 7½ cents	5.35
Engineer's wages on operation	330.41
Fireman's wages on operation	164.83
3½ gals. kerosene at 10 cents	.35
1 can of tar at 28 cents	.28
Total	$ 945.67

Daily Expense.

Supervisor's wages	$2.28
Engineer's wages	3.50
Fireman's wages	1.75
Coal	3.55
Cylinder oil	.21
Black oil (gears)	.03
Grease (cups and gears)	.20
Kerosene	.003
Tar	.002
Waste	.06
Depreciation	6.417
Interest	.961
Repairs	3.33
Total	$22.293

Tonnage Hauled.

August 1, 1910	1,681
September 1, 1910	1,525
October 1, 1910	1,176
November 14, 1910	284
Total tons	4,666

Cost Per Ton Hauled.

Operation	$945.67÷4,666=	$0.202
Repair	310.17÷4,666=	0.066
Depreciation	596.78÷4,666=	0.128
Interest	89.37÷4,666=	0.017
Supervision	239.40÷4,666=	0.051
		$0.464

Extreme haul, 9.44 miles. Start, 5 miles. Average length of haul, 7.22 miles round trip; 2.24 trips daily; 209 trips, or 1,508.98 miles in 93 days.

Adaptability of Small Mixer

By J. H. Powers, Powers-Snyder Co., Contractors, Binghamton, N. Y.

Placing concrete by means of the hoisting tower and chutes, a method which has lately come into wide use, is economical only on operations of very considerable size. On residence work, silos, and other structures requiring only comparatively small volumes of concrete, the tower and chute equipment and its operation involve prohibitive expense. We have adopted the use of concrete mixers equipped with a quick-acting hoist, connected direct to the engine, making a complete, compact outfit, which is easily and profitably used wherever concrete has to be not only mixed, but hoisted into place. This hoist consists of two standards sup-

The Merger of East and West

"But there is neither East nor West, Border, nor Breed, nor Birth,
When two strong men stand face to face, tho' they come from the ends of the earth!"
—KIPLING.

In the "Ballad of East and West," Kipling tells the story of an Indian border bandit pursued to his hiding place in the hills by an English colonel's son.

These men were of different races and represented widely different ideas of life. But, as they came face to face, each found in the other elements of character which made them friends.

In this country, before the days of the telephone, infrequent and indirect communication tended to keep the people of the various sections separated and apart.

The telephone, by making communication quick and direct, has been a great cementing force. It has broken down the barriers of distance. It has made us a homogeneous people.

The Bell System, with its 7,500,000 telephones connecting the east and the west, the north and the south, makes one great neighborhood of the whole country.

It brings us together 27,000,000 times a day, and thus develops our common interests, facilitates our commercial dealings and promotes the patriotism of the people.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy ***One System*** ***Universal Service***

porting the drum and main gear; the driving pinion is attached to the friction drive, which is in turn attached to the engine.

We find that this method enables us to elevate concrete at lowest cost. We hoist three buckets of concrete at a time no matter whether mixer is full of concrete or not. The machine used in this work, which is furnished by the Jaeger Machine Co., Columbus, Ohio, is equipped with a 2½-h.p. engine. The hoist lifts 300 pounds easily over a common block at the rate of 60 to 80 feet per minute with both hoist and mixer operating at same time or singly, at a cost of approximately 4½ cents per hour for gasoline. This machine, which has a drum capacity of two wheelbarrow loads, is operated and easily moved on the job by two, three or four men who will accomplish several times the work that can be done by the same number of men mixing by hand. The simple, compact design with no charging device makes it ready for operation the moment it arrives on the job, and it is frequently possible to have a large part of the concrete in place with this machine before a cumbersome mixer with a charging elevator could be set up ready for operation. It is built especially for sidewalk, curb and gutter construction, for small sewers and house foundations, mixing cement mortar, making cement blocks and for concrete floors, small bridges and culverts; in fact doing all the mixing of the average contractor and builder.

Obtaining the proper proportions does not guarantee first class concrete. Proper mixing counts for much. The sand and cement should be first mixed dry and then mixed wet into a homogeneous mortar. The coarse aggregate, previously drenched, should be added to this mortar, and all thoroly mixed together. This practice can be followed in either hand or machine mixing, provided a batch mixer is used. On small work, hand mixing is no longer the most popular. It is our opinion that the job so small that a small mixer cannot be employed to advantage is not worth considering. Oftentimes mixing is sorely neglected, being intrusted without proper supervision to laborers who have little appreciation of what is really necessary and less interest in final results. Machine mixing on the smallest jobs, when the batch type of mixer is used, is much more certain and reliable than hand mixing.

Generally speaking, wet concrete will give better results than dry, and tho it is not practicable to use as wet concrete in sidewalk construction as in some other classes of work, the concrete should be mixed with as much water as it will stand and permit of thoro tamping. Probably all who have had anything to do with mixing concrete by hand have noticed that the mass becomes more moist as the mixing progresses. This is because the particles are being forced into closer contact, and indicates that the object of the mixing is being accomplished. The same plasticity is apparently obtained by the use of an excess of water and less mixing. This does not give the same results and should never be substituted for thoro mixing. The mixing should always be conducted in a manner which will not permit of the loss of cement thru the running off of surplus water.

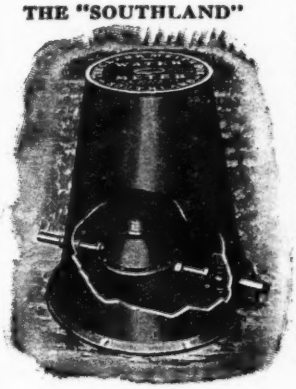
A sack of cement has a net weight of 94 pounds, and can be considered in volume as equal to 1 cubic foot, which greatly simplifies proportioning.

Concrete is no stronger than its aggregate. It makes no difference how well the cement may test, if the gravel, sand or stone does not possess the necessary requisites, the job will be a failure. Good appearing sand or gravel will sometimes develop characteristics which may disfigure and even destroy the work into which it enters. Quite often, shaly pebbles which are not noticeable except under careful scrutiny will, when used in the concrete, disintegrate, and in so doing expand, breaking out large pieces of top mortar. When such particles occur in the sand, the disintegration gives the whole surface a pitted appearance, disfiguring the work. Clay is also detrimental when occurring as a coating on the particles, and in many places it is absolutely necessary to provide a washing apparatus, which will remove it. Many installations of commercial types of washers are in satisfactory use. However, by spreading the material out on a loose board platform in small quantities and turning on a stream from a ¾-inch garden hose, very satisfactory results have been obtained. When the job is not too large, this same process can be applied to the washing of the sand.

It is our contention that our type of mixer is most economical on all jobs, no matter what the size of the work. Before the purchase of our mixer, we, of course, did all hand mixing and the comparison of costs is interesting. By the use of hand mixing the average yardage secured per man, including everybody in the organization, was 2.31 cubic yards, as against 3.83 cubic yards secured by machine mixing. Including only those actually engaged in mixing and depositing concrete, the average was 3.04 cubic yards for machine mixing. In arriving at the machine figure, the three men operating the machine were included, since they replace the mixers on the boards. In the latter figure, the foreman, the finisher and his helper and the form setter were not included.

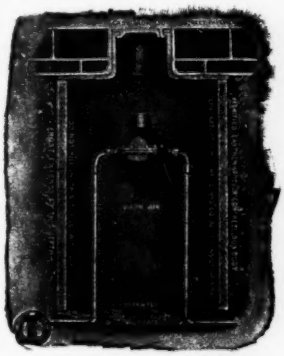
CLARK METER BOXES

THE "SOUTHLAND"



are manufactured in sizes and shapes to properly house any kind or size of water meter, whether it is to be installed in the frigid north or the torrid south.—We would like to tell you more here about the largest and most complete line of water meter boxes manufactured—but space does not permit.—Our catalog is yours for the asking.—State depth of service and number of meters to be installed during the year—and we will do the rest.

THE "NORTHLAND"



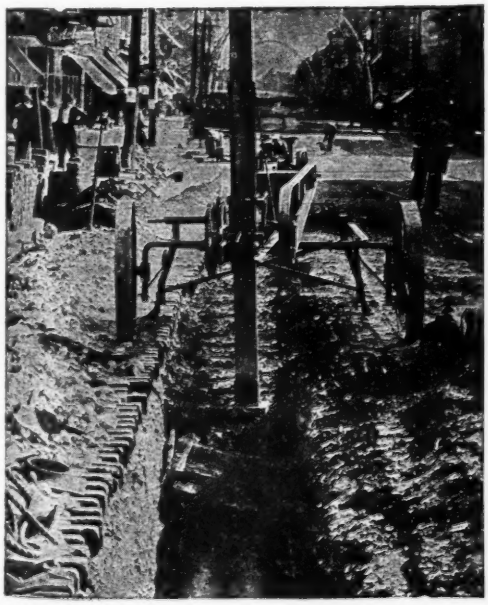
The Box Body, quite often made of concrete in our well-known Iron Collapsible Form, reduces the "first cost" to the minimum. The **"Clark Meter Box"** may be used with or without the cast iron base. In extremely wet localities, the base assures perfect watertightness.

"TEKSAGON" Meter Couplings require no Gaskets, therefore eliminate leaks, choked waterways, and reduce meter maintenance. You should use them on all of your Meters.

H. W. CLARK CO. 1512 Broadway **Mattoon, Ill., U.S.A.**

Manufacturers of Water Meter Boxes for Every Meter—Valve Boxes—Roadway Covers—Collapsible Forms for making Concrete Meter Box Bodies and Tile—Meter Couplings—Gauges—Deep Well Constructions, Pump Plungers; Etc.

Staley Power Tamping Machine



saves eight out of ten men

Pavements can follow immediately over trenches that have been tamped by this machine without danger of future depression.

—Straddles any width trench up to 4 feet.

—Eighty-five pound, 8x8 inches, tamp strikes 56 blows per minute at any point at any level from one to six feet below surface.

—Pounds dirt into solid, compact mass from bottom to top of backfill, thus obviating all sinking of trenches and consequent pavement repairs.

—Pavements can be immediately laid over **Staley tamped** trenches without any danger of further depressions.

—Can be used for tamping sidewalk paving, sewer and concrete construction.

—Special attachments for cutting asphalt and concrete pavements.

No more sinking of trenches if Staley Tampers are used.

Write for Proposition, Complete Information and Prices.

Lourie Mfg. Co.
SPRINGFIELD, ILLINOIS.

CONTRACTING NEWS

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Bluffton, Ind.—Sept. 18, until 10 a. m., for the construction of a gravel road on county line between Wells and Grant counties. L. A. Williams, auditor Wells county; E. H. Kimball, auditor Grant county.

Chicago, Ill.—Sept. 11, until noon, for excavation and collateral work on Section 9 of the Calumet-Sag channel. The approximate quantities to be used in comparison of proposals are: (a) 875,000 cubic yards of excavation of glacial drift, (b) 50,000 cubic yards of excavation of solid rock, (c) 70,000 square yards of rip-rap slopes, (d) 1,750 lineal feet of roadway construction, (e) 1,100 cubic yards of No. 1 concrete, (f) 1,350 cubic yards of No. 2 concrete, (g) 90,000 pounds of reinforcing metal. Thomas A. Smith, president board of trustees of Sanitary District of Chicago.

Cincinnati, O.—Sept. 12, until noon, for the following county work: Under Specification No. 132 for the improvement of the Banning road, from corporation line of Mt. Airy to Blue Rock pike in Colerain township; certified check, $2,000. Under Specification No. 515 for the improvement of the Ohio pike, from Station 79 to Bogart road in Anderson township; certified check, 1,000. Albert Reinhardt, clerk board of Hamilton county commissioners.

Cincinnati, O.—Sept. 5, until noon, for the following county work: Under Specification No. 536 for the improvement of Evendale road, from Chr. Jentz's mail box at Stop 41 on Madison avenue in Sycamore township; certified check, $2,000. Albert Reinhardt, clerk Hamilton county commissioners.

Columbus, O.—Sept. 5, until noon, for furnishing all the labor and material necessary to construct, build and complete the following work: Engineer's estimate No. 477 for improving and macadamizing the Atcheson road in Clinton and Mifflin townships; engineer's estimate No. 510 for constructing the Waterman road in Franklin township; engineer's estimate No. 515 for repairs on Greenlawn avenue, between the Scioto river and the Jackson pike, Franklin township; engineer's estimate No. 524, Plan B, for constructing the west approach on the Wilson bridge over the Olentangy river, Sharon township; engineer's estimate No. 534 for furnishing, hauling and spreading crushed limestone and screenings on the road west of the Olentangy river, north and south of Lane avenue, and on Lane avenue just west of the River road in Clinton township. Each and every bid shall be accompanied by a certified check, payable to the order of the board of county commissioners, or cash in the sum of $200 on estimates Nos. 515 and 524. The work comprised in estimates Nos. 477, 510 and 515 shall be fully completed on or before the first day of December, 1913. The work comprised in estimate No. 534 shall be fully completed on or before the first day of November, 1913. The work comprised in estimate No. 524 shall be fully completed on or before the first day of July, 1914. Upon failure to complete the work within the time specified, the contractor or contractors shall forfeit to the county of Franklin the sum of $10 a day for each and every day that may elapse between the time specified for the completion of work and the final completion. John Scott, clerk board of Franklin county commissioners.

Columbus, O.—Sept. 5, until 10 a. m., for grading and paving with concrete the Ohio River road in Marietta township, Washington county. Length, 6,700 feet, or 1.27 miles; width of pavement, 16 feet. Estimated cost, $16,479.30. Certified check, $300. Bond, 150 per cent. of contract price. Date of completion, August 1, 1914. James R. Marker, state highway commissioner.

Columbus, O.—Sept. 5, until 10 a. m., for grading and paving with brick for heavy traffic, the McConnelsville-New Lexington road, in Malta and Deerfield townships, Morgan county. Length, 6,000 feet, or 1.14 miles; width of pavement, 12 feet. Estimated cost, $22,647.20. Certified check, $300. Bond, 150 per cent. of contract price. Date of completion, August 1, 1914. James R. Marker, state highway commissioner.

Columbus, O.—Sept. 15, until 10 a. m., for grading and paving with water-bound macadam, the following roads: The Pomeroy-Jackson road, Lick township, Jackson county; length, 18,000 feet, or 3.41 miles; width of pavement, 12 feet; estimated cost, $13,290; certified check, 300; bond, 150 per cent. of contract price; date of completion, August 1, 1914. The Steuenbville-Cambridge road, in Moorefield township, Harrison county; length, 6,600 feet, or 1.25 miles; width of pavement, 12 feet; estimated cost, $9,464; certified check, $300; bond, 150 per cent. of contract price; date of completion, August 1, 1914. The Milan-Elyria road, in Milan township, Erie county; length, one mile;; width of pavement, 12 feet; estimated cost, $5,546.60; certified check, $300; bond, 150 per cent. of contract price; date of completion, August 1, 1914. The Cleveland-Sandusky road, in Huron township, Erie county; length, 7,920 feet, or 1.50 miles; width of pavement, 12 feet; certified check, $300; bond, 150 per cent. of contract price; date of completion, August 1, 1914. James R. Marker.

Columbus, Ind.—Until Sept. 8, for the paving of Second street, from the White river bridge to the Haw creek bridge; for making the fill on the low part of Second street, and for building an 84-foot extension to the Haw creek bridge. Time allowed for completion, one year. Estimated cost of work, $30,000. Wm. H. Rights, city engineer.

Danville, Ind.—Sept. 8, until 10 a. m., for the construction of a road in Middle township, Hendricks county. Lewis W. Borders, auditor.

Dodge City, Kans.—Sept. 5, until 6 p. m., for construction of Third avenue brick pavement on concrete base, in paving district No. 1, consisting of approximately 12,800 square yards, together with the necessary excavation, curbs, gutters and appurtences. Certified check, $1,000, drawn on some local bank. W. E. Baldry, city engineer; S. Gallagher, city clerk.

Jonesboro, Ark.—Until Sept. 7, for furnishing labor and material for laying approximately 10,000 square yards of brick pavement, including drainage and curbing. B. H. Berger, secretary of board of commissioners for street improvement district No. 10.

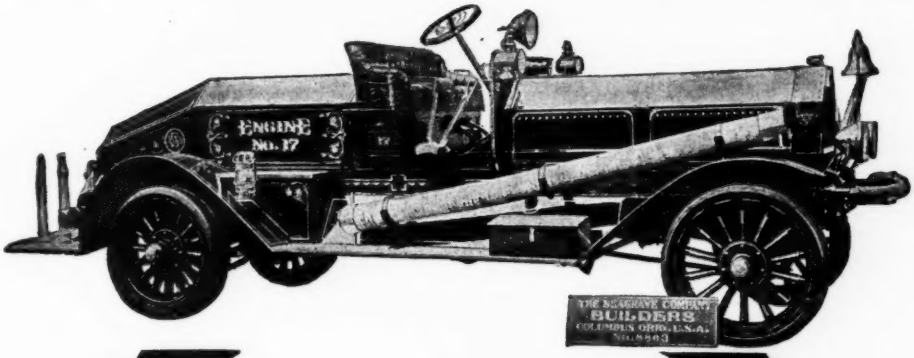
Lake Charles, La.—This city is now advertising for bids for about 85,000 yards of street paving. For further information, address G. L. Riling, mayor.

New Orleans, La.—Sept. 8, until noon, for the construction of a public highway, between Mansfield and Benson in DeSoto Parish, a distance of 12 miles. W. E. Atkinson, state highway engineer, room 104, New Orleans Court building.

CONTRACTS AWARDED.

Bloomfield, N. J.—The Standard Bitu-

Multi-Stage-Centrifugal Pumping Engine



1000 Gallons per minute at 120 lbs. Pump Pressure
600 Gallons per minute at 200 lbs. Pump Pressure

SEAGRAVE

Built in two sizes, 750 and 1000 gallons capacity per minute at 120 lbs. Pump Pressure and can be furnished with or without hose body and chemical tanks, as desired.

Delivers More Gallons Per Minute at Higher Pressure than Any Other Pumping Engine in the World

No wearing parts
No relief valves
Slow speed motor

No springs
No vibration
High efficiency

Visit the Seagrave Display at the Show

Watch our Competitors Follow Our Lead.

THE SEAGRAVE COMPANY

COLUMBUS, OHIO

lithic Co., of Newark, N. J., was awarded the contract for paving Dodd street. Contract price, $6,373.16.

Cadiz, O.—Contract for brick paving has been awarded to Herman Coss and A. C. Meyer, of Wheeling, W. Va., at $24,059.

Canton, O.—The paving of the Canton-Massillon highway has been awarded to the Campbell-Downs Construction Co., of this city. Bid, $36,034.

Hiawatha, Kans.—The Chopin Construction Co., of Kansas City, Mo., was awarded the contract for construction of 12,000 square yards of Dolarway pavement.

Iowa Falls, Ia.—The Dearborn Construction Co. has been awarded the contract for the additional paving at Eldora.

Leon, Ia.—Contract for paving, to be done in Leon this summer, was awarded to Ford Paving Co., of Cedar Rapids, bid being $79,962.28.

Marshall, Mo.—13,000 square yards of Dolarway paving has been awarded J. M. Clark, of Nevada, Mo., at bid of $1:43.

Memphis, Tenn.—L. W. Johnson has been awarded 5,000 square yards of Dolarway paving at bid of $1.33, and H. B. Fowler 10,000 square yards of same at $1.29. Both are local contractors.

Monroe, Wash.—Pugh & Arenz, of Salem, Ore., were awarded the contract for paving Madison, West Main and East Main streets with Portland cement concrete, about 13,509 square yards, at cost of $20,485.

Pittsburgh, Pa.—Contracts for city improvements were awarded as follows: Repaving (wood and block stone) South Main street, to Thomas Cronin Co., at $5,225.75; (with asphalt) Sheffield street, to Booth & Flinn, Ltd., at $1,082.28; cement sidewalks, approach to Stieren street bridge, to Wadsworth Stone Paving Co., at $1,190.40; West Carson street, to Griffith Concrete and Construction Co., at $1,500.83; retaining walls, South Eighteenth street, to W. J. Payne, Jr., Co., at $1,678; Chislett street, to M. D'Herron Co., at $9,100.25. All are local firms.

Rahway, N. J.—Contract for paving with asphalt block on Irving street has been awarded to Hastings Paving Co., of New York City, at $24,250.

Rochester, N. Y.—Contracts have been awarded by board of contract and supply for paving with wood block Genesee street, and with asphalt Troup street, to Whitmore, Rauber & Vicinus, 279 South avenue, at $108,950 and $19,332, respectively.

Salt Lake City, Utah—Contract for paving Seventh South street and Fifth South street has been awarded to I. J. Moran, 152 West Second South street, at $60,105.

San Francisco, Cal.—G. W. McGinn & Co., Phelan building, were awarded the contract for paving with asphalt San Bruno avenue. Contract price, $16,000.

SEWERS.

Queens Boro, New York City.—Bids are now being advertised for the construction of an outlet trunk sewer to drain 6,000 acres or 78,000 city lots. The district, which it is predicted will ultimately contain a population of a million, includes sections now in a state of development. In the large area are developments in Elmhurst, Winfield, Woodside, Maspeth, Astoria, North Beach, Forest Hills, and others on the border line between the Fourth ward and Kings. According to estimates of the engineers of of the board of estimate and the Queens sewer bureau, the trunk sewer will cost $1,145,790. Inasmuch as in certain sections the trunk sewer will be from 90 to 100 feet below the present surface grade, tunnelling operations will be resorted to in the construction of the sewer. Maurice E. Connolly, president of boro.

Spencer, Ia.—Sept. 5, until 8 p. m., for the construction of sewers as follows: Beginning in the present Main street sewer at the intersection of Main and River streets, and running east along the center line of East River street, a distance of 872 feet, there terminating. Maximum depth of sewer, 9.75 feet; minimum depth, 7.25 feet; average depth, 8.5 feet; said sewer to be provided with 32-inch "Y" connections, four catch basins, and two manholes. Sewer to be constructed of 8-inch glazed, first quality vitrified sewer pipe, solidly cemented at the joints, approved covers to be provided for the manholes and catch basins, and to be completed within 60 days of time of letting. Certified check for $100, payable to E. Taggart, city treasurer; Etta M. Smith, city clerk.

CONTRACTS AWARDED.

Great Falls, Mont.—Contracts have been made with the following firms for sewer work in various districts: Nilson-Smith Co., Great Falls, $4,400; Hanlon & Oaks, Sioux City, Ia., $13,750; F. E. Evans Contracting Co., Great Falls, $6,100.

Linton, Ore.—The James Kennedy Construction Co., of Portland, Ore., was awarded the contract for the construction of a complete sewerage system.

Mason City, Ia.—S. R. Bowen, a local contractor, was awarded the contract for constructing a sanitary sewer on East Drummond street. His bid was as follows: Seventy-five cents per cubic yard earth excavation and back filling; $2.25 per cubic yard loose rock excavation and back filling; $5.50 per cubic yard hard rock excavation and back filling; 25 cents per foot for 8-inch pipe furnished and laid; $1.25 additional for 6 or 8-inch Y branch, $1.50 manhole complete. F. P. Wilson, engineer.

CONTEMPLATED WORK.

Carthage, Mo.—The building of a main sewer leading from the corner of Main street and St. Louis avenue to a point on Spring river, a distance of about 3 miles, is being considered. Estimated cost, $24,107.75. Frank Newton, city engineer.

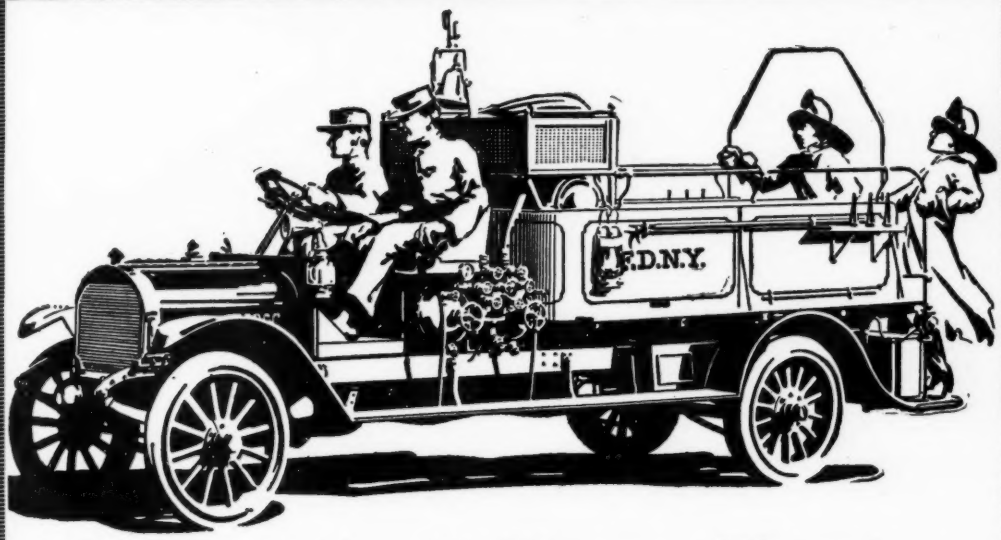
Indianapolis, Ind.—Plans for the construction of sewers in the following streets have been adopted by the board of public works: Rookwood avenue from Fortieth to Forty-fourth street; alley east of Applegate street, from Legrande avenue to Raymond street; Senate avenue, from Fortieth to Forty-fourth street; Burdsal parkway, from Schurmann avenue to Belt railway tracks; Adelaide street from New York to Ohio street; Bolton avenue, from Julian avenue to a point 262 feet south; Gladstone avenue, from St. Clair street to a point 520 feet north; Langley avenue, from Roosevelt avenue to Hazel street; alley west of Olney street, from Twentieth to Twenty-first street, and alley north of Twenty-fifth street, from Clifton to Annetta street.

Waterloo, Ia.—The village board has adopted a motion providing work on the sanitary sewer system to be started at once. The system will consist of 14 miles of 6 and 20-inch pipe sewer, 400 feet double 14-inch siphon under the Seneca river, septic tank, sludge beds and pumping station. C. A. Roby, engineer.

WATER WORKS.

BIDS REQUESTED.

Baltimore, Md.—Sept. 10, until 11 a. m., for furnishing and erecting pumping machinery and filtration plant, Water Department Contract No. 19. Plans and specifications can be obtained at the office of Ezra B. Whitman, the water engineer, City Hall, Baltimore. A charge of $5.00 will be made for each set of plans and specifications. The extent of the work is as follows: One



International Motor Trucks
MACK and SAURER

NEW YORK CITY RE-ORDERS
INTERNATIONAL APPARATUS

Every city official should know how Greater New York City secured dependable fire apparatus. You should write us for a copy of the New York specifications. They cover every essential detail of motor and fire apparatus construction.

Of all the competing high pressure trucks, ours were the only ones that met the specifications and stood the tests.

Contracts were awarded for 33 pieces of our apparatus. On delivery each of these was rigidly checked against the specifications. Then the apparatus was subjected to the heavy and exacting test run. Each of the 33 pieces readily passed the inspection and tests.

Now after months of actual service with International apparatus, the Purchasing Board has re-ordered ten more International High Pressure Trucks.

The history of this award will be of great value to you. We will gladly furnish the data upon request.

Write today.

INTERNATIONAL
MOTOR COMPANY

General Offices, Broadway and 57th St. **NEW YORK CITY.**

horizontal centrifugal pump of 35,000 gallons capacity, two horizontal centrifugal pumps of 28,000 gallons capacity; one horizontal centrifugal pump of 21,000 gallons capacity; one 2-stage underwriters' pump of 750 gallons capacity; three vertical centrifugal pumps of 4,000 gallons capacity; two vertical centrifugal (Sump) pumps of 200 gallons capacity; two vacuum pumps; placing, piping and valves.

Baltimore, Md.—Sept. 10, until 11 a. m., for furnishing and erecting electric power equipment for filtration plant, Contract No. 20, water department. Plans and specifications can be obtained at the office of Ezra B. Whitman, the water engineer, City Hall, Baltimore. A charge of $5.00 will be made for each set of plans and specifications; this amount will be refunded. The extent of the work is approximately as follows: For furnishing and erecting four 400-K.v.a. transformers, one 50-K.v.a. transformers, circuit breakers and high tension switchboard, one 9-panel low tension switchboard. All wiring and starters for connecting up various motors; for furnishing the following motors: One 400-h.p. motor; two 350-h.p. motors; one 250-h.p. motor; one 75-h.p. motor; three 50-h.p. motors.

Jacksonville, Fla.—Sept. 15, until 10 a. m., for furnishing and erecting complete, at the water works, on foundation to be provided by city, one high duty horizontal cross compound or triple expansion condensing pumping engine, together with all necesary appurtenances, guaranteed duty to be not less than 135 million foot-pounds per 1,000 pounds of dry steam, and to have a capacity of twelve million gallons in 24 hours against a total dynamic head of 170 feet when pumping into mains for domestic use and be able to pump the same quantity against a dynamic head of 270 feet for fire service with a steam pressure of 145 pounds at the throttle. As an alternative proposition prices are requested also for an engine of same general design having a capacity of fifteen million gallons in 24 hours. For specifications in detail and other information, apply to E. L. Carroll, superintendent waterworks, Engineering building, Jacksonville, Fla. Envelopes containing bids should be addressed to the chairman of the board and each be plainly marked as a bid on waterworks pump. The board reserves the right to reject any and all bids. W. M. Bostwick, Jr., chairman.

Taylorvile, Ill.—Sept. 8, until 1 p. m., for the following waterworks equipment: One high duty, compound, condensing, duplex, direct acting, 750,000 gallons daily capacity; four deep well pumps complete; four small brick houses for deep well pumps; two boilers, 100-h.p. each; one stack, 42 inches diameter, 60 feet high; putting concrete lining in brick well, steam piping water connections for pump and boilers. Plans and specifications are in the office of the city clerk or in the office of Hiram Phillips, consulting engineer, 716 International Life building, St. Louis, Mo.

BRIDGES.

BIDS REQUESTED.

Bowling Green, O.—Sept. 8, until 2 p. m., for furnishing the labor and material for construction of the superstructures and substructures over Portage river, one located near the east quarter post, Section 21; the other near New Rochester, both in Freedom township, Wood county. The commissioners also invite and will receive and consider proposals on any other plans at the option of the bidders in accordance with Section No. 2345, General Code of Ohio. Bids will be received on separate parts of said improvements as follows: (1) On substructure complete on each bridge as per plans and specifications on file in county auditor's office; (2) On superstructures complete of each bridge as per plans and specifications on file in county auditor's office; certified check, $500, required with each bid for substructure, and $100, for superstructure, and made payable to H. J. Rudolph, county treasurer. Bids for the old wooden superstructure of bridge near New Rochester will be received at same time, but must be separate from bids received on substructure and superstructure of new bridge. Said bid must be conditioned upon prompt removal of old superstructure so as to not interfere with erection of substructure of new bridge. C. E. Stinebaugh, auditor.

Portsmouth, O.—Sept. 4, until 1 p. m., for furnishing labor and material for the construction and erection of the steel superstructure and wood sidewalk flooring for a bridge crossing the Scioto river at Portsmouth, consisting of four 336-foot spans and three 49-foot spans. Certified check, 5 per cent. of bid. Thos. C. Patterson, auditor Scioto county.

AUTOMOBILES—FIRE APPARATUS.

Grank Forks, N. D.—This city is in the market for a 65-foot aerial truck, two or three-horse hitch. Will consider a second-hand one if in good condition and price reasonable. Orr Sanders, chairman fire committee.

Kansas City, Mo.—J. C. Egner, chief of fire department, advises the purchase of three more chiefs' cars is being considered.

Philadelphia, Pa.—Abington Fire Co. No. 1, a volunteer organization, is to have a modern automobile type of fire-fighting apparatus, to cost approximately $4,000. Charles O. Kruger heads the committee, appointed to raise the funds, other members being Assemblyman Chas. A. Ambler, Harry S. Ambler, Jr., William Ferguson and Charles Bates.

Springfield, Ill.—Bids will be asked at once by H. B. Davidson, commissioner of public safety, for one motor combination chemical and hose wagon and one tractor to be attached to a steamer.

Washington Court House, O.—Ordinance was passed to use $10,000 in bonds for the early purchase of motor fire engine and other modern fire-fighting equipment. Mr. Flynn, city clerk; Mr. Smith, mayor.

BUILDINGS.

BIDS REQUESTED.

Oberlin, La.—Bids will be received until September 4, for the construction of a court house, which will cost about $75,000. The building is to be constructed of fire-proof material. The skeleton of the structure will be of reinforced steel and concrete and the exterior will be light gray pressed brick, with light gray oolitic limestone trimmings with gray terra cotta belt courses and cornices to match. The interior of the building is to be finished in cement plaster, hard, white finish with ornamental plaster cornices and wall paneling, the interior woodwork being oak. The building is to be modern in every respect, being equipped with electric lights and modern plumbing.

LIGHTING.

Houston, Tex.—The city of Houston is contemplating the installation of a municipal electric light plant. At first the plant will furnish electricity for municipal purposes only. Mr. Campbell, mayor.

Mackinac Island, Mich.—The Municipal Water, Light & Power Co. expects to purchase within the next six months a 250-k.w. direct connected generating unit for lighting load. A. J. Doherty, Jr., is secretary and treasurer.